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1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
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This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

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The November 1977-January 1978 issue begins Volume 5 of OIL SPILL AND OIL POLLUTION REPORTS, a quarterly compilation of abstracts of current oil pollution-related literature and research projects. Comprehensive coverage of terrestrial and aquatic oil pollution and its prevention and control is provided, with emphasis on the marine environment. The report contains (a) citations and summaries of 1975 to 1977 publications and patents; (b) status and summaries of current research programs; and (c) information on current oil pollution-related meetings. This report is submitted in partial fulfillment of EPA Grant No. R-805052-01 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the U.S. Environmental Protection Agency.

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OIL SPILL AND OIL POLLUTION REPORTS

Volume 5 Number 1

(November 1977 – January 1978)

by

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FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report is a product of the above efforts. It cites current events, literature, research, patents, and other materials relevant to the oil pollution abatement program and is published in an abstract format on a quarterly basis. As such, it serves as a basic reference document for all those interested in oil spill and oil pollution control. This project is part of the continuing program of the Oil and Hazardous Materials Spills Branch, IERL-Ci, to assess and mitigate the environmental impact of oil pollution.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

ABSTRACT

The November 1977-January 1978 issue begins Volume 5 of OIL SPILL AND OIL POLLUTION REPORTS, a quarterly compilation of abstracts of current oil pollution-related literature and research projects. Comprehensive coverage of terrestrial and aquatic oil pollution and its prevention and control is provided, with emphasis on the marine environment. The report contains (a) citations and summaries of 1975 to 1977 publications and patents; (b) status and summaries of current research programs; and (c) information on current oil pollution-related meetings. This report is submitted in partial fulfillment of EPA Grant No. R-805052-01 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the US Environmental Protection Agency.

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INTRODUCTION

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin which reviews pertinent scientific and technical publications and research projects to provide its readers with current developments in the field of oil pollution. This issue contains summaries of articles, reports, patents, documents, and other literature relating to oil pollution published during the period 1975 to 1977 (Section I); summaries and status of current research projects (Section II); and current oil pollution-related conferences (Section III). Beginning with this issue, the reports will be identified by volume and issue number; previous issues were identified by quarterly dates alone, as shown on the following page.

Subject coverage includes aquatic and terrestrial oil pollution with emphasis on the marine environment. Items in Section I are categorized by seven major subdivisions which are divided into thirty-seven specific subject categories. Categories used in the current issue are presented in the Table of Contents. Patents and patent applications are announced under appropriate subject categories. A list of the periodicals reviewed in preparing this series appears in the Appendix.

Section II presents titles of active or recently completed oil pollution research projects, summaries of project objectives, and current status information and/or resulting publications provided upon request by the principal investigators or performing organization. Notices of research projects are obtained primarily from the Smithsonian Science Information Exchange (SSIE). Entries are arranged according to the same subject categories as in Section I. Some of the projects listed in previous Oil Pollution Reports have been recently renewed. These projects have been relisted with a current serial number, followed by the original number in parentheses.

Entries in Section I and II have separate serial numbers. The letters preceding the serial numbers designate the following: C, reports, publications, and patents; and R, research projects. Subject, author, and patent indexes are provided at the end of the report.

Section III, Current Conferences, contains descriptive information on recently held and upcoming conferences relevant to any aspect of oil pollution. Conference dates are listed; and, when information is available, titles, authors, and abstracts of oil pollution-related papers are included. All information for this section was obtained from the periodicals reviewed (Appendix) and from responses to written inquiries concerning the meetings.

OIL SPILL AND OIL POLLUTION REPORTS

Environmental Protection Technology Series

Reports currently available, in press, or in preparation.

	Dates Covered	Report Number
1974	July 74 - Oct. 74	EPA-670/2-75-003
1975	Nov. 74 - Feb. 75	EPA-670/2-75-044
	Feb. 75 - Apr. 75	EPA-670/2-75-059
	May 75 - July 75	EPA-600/2-76-129
	Aug. 75 - Oct. 75	EPA-600/2-76-113
1976	Nov. 75 - Jan. 76	EPA-600/2-76-185
	Feb. 76 - Apr. 76	EPA-600/2-76-215
	May 76 - July 76	EPA-600/2-76-266
	Aug. 76 - Oct. 76	EPA-600/2-77-037
1977	Nov. 76 - Jan. 77	EPA-600/2-77-075
	Feb. 77 - Apr. 77	EPA-600/2-77-111
	May 77 - July 77	EPA-600/2-77-243
	Aug. 77 - Oct. 77	Submitted 11/77
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Vol. 5 No. 2	Feb. 78 - June 78	in preparation

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ABBREVIATIONS

atm	atmosphere
bbl	barrel
°C	degrees Centigrade
cm	centimeter
dwt	dead weight ton
EIS	environmental impact statement
°F	degrees Fahrenheit
ft	foot
g	gram
gal	gallon
GLC	gas-liquid chromatography
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
ha	hectare
hr	hour
in	inch
IR	infrared
kg	kilogram
km	kilometers
kn	knot
L	liter
lb	pound
LD	lethal dose
LNG	liquefied natural gas
LOT	load on top
LPG	liquefied petroleum gas
m	meter
mg	milligram
mi	mile
min	minute
ml	milliliter
mm	millimeter
OCS	outer continental shelf
oz	ounce
PAH	polycyclic aromatic hydrocarbon
pH	the negative log of the H ion concentration
ppb	part per billion
ppm	part per million
sp.	species
TLC	thin-layer chromatography
US	United States
USSR	Union of Soviet Socialist Republics
UV	ultraviolet
VLCC	very large crude carrier
WSF	water soluble fraction
wt	weight
yr	year
µ	micron
µg	microgram
%	percent
/	per

ACRONYMS

API	American Petroleum Institute
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
DOE	Department of Energy
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FEA	Federal Energy Administration
IMCO	International Maritime Consultative Organization
NASA	National Aeronautics and Space Administration
NBS	National Bureau of Standards
NOAA	National Oceanic and Atmospheric Administration
NTIS	National Technical Information Service
UN	United Nations
USCG	United States Coast Guard (DOT)
USGS	United States Geological Survey
USDI	United States Department of Interior
USDA	United States Department of Agriculture
USN	United States Navy

SECTION I. REPORTS, PUBLICATIONS, AND PATENTS

A. OIL POLLUTION DETECTION AND EVALUATION

1. REPORTING

C-0001-78
MARINE POLLUTION: A MULTI-FACETED, MULTI-AGENCY DETECTION, RESEARCH AND ENFORCEMENT PROGRAM
Anon. 1977.
Sea Technology 18(10):10-17, 49-50.

Argo Merchant spill, Detection, Monitoring, Law enforcement, Sampling, Government agencies

A section of this article, "Oil Pollution," describes efforts of the agencies involved in the Argo Merchant spill. In addition to the Coast Guard, NOAA's Environmental Research Laboratories, National Weather Service, and Environmental Data Service became involved. Woods Hole Oceanographic Institution sent a research vessel to the scene. Methods of study of the oil slick generated by the ship's grounding are described.

C-0002-78
METULA SPILL EFFECTS MAY LAST 20 YEARS (news brief)
Anon. 1977.
Sea Technology 18(8):26.

Metula spill, Chronic effects, Beaches, Estuaries, Intertidal zone, Chile

Roy G. Hann, Jr., professor of engineering at Texas A&M University, has returned to the Chilean coastline three years after the August, 1974, Metula spill. Above the high tide line on the open beach is a band a few meters wide of oil, sand, and trash which he expects will be evident for 10-15 years. Two small estuaries contain fresh, soft pools of oil which should have visible effects there 20 years from now. An intertidal area 0.4 km (¼ mi) wide and 3 km (2 mi) long is paved with oil 5-25 cm (2-10 in) deep in the sediment which may still be eroding 7-10 years from now.

C-0003-78
WARNING ON CUMULATIVE OIL SPILLS ON MARINE LIFE (news brief)
Anon. 1977.
Western Fisheries 94(6):19.

Oil spills, Marine organisms, Fisheries, Ekofisk blowout, Chronic effects

An oceanographer, Dr. Gerhard Tomczak, of the Food and Agriculture Organization of the UN, was reported as saying that marine resources may be seriously impacted by oil spills. He warned that the Ekofisk spill would first damage birds, then fish, but that the effect on fisheries would not be felt for two or three years.

C-0004-78
AUDUBON VERSUS LIBERIA (news brief)
Bourne, W.R.P. 1977.
Marine Pollution Bulletin 8(8):171.

Argo Merchant spill, Statistics, Oil Spills, Tankers

The author briefly reviews *Audubon* coverage of oil spill disasters including statistics of numbers of gallons of oil lost and tankers declared a total loss. Details are given on the appalling history of the *Argo Merchant*.

C-0005-78
OIL-SPILL IN THE HUDSON RIVER (news brief)
Bourne, W.R.P. 1977.
Marine Pollution Bulletin 8(8):171.

Oil spills, Ice, *Hudson River

A Hess Oil Company barge was grounded on a reef in the Hudson River by a tug belonging to another company on February 4, 1977. Fifteen-hundred tons of No. 6 high-pour oil were lost, with ice acting as a boom while the oil congealed. Coasts to the south and east and a number of birds were affected by the spill.

C-0006-78
AN OILY SPRING (news brief)
Bourne, W.R.P. 1977.
British Birds 70(8):352-353.

Oil spills, Birds, Statistics, UK, North Sea

Five significant oil pollution incidents occurred between February and May, 1977, at Dounreay, Scapa Flow, Bempton (twice), and the Ekofisk field in the North Sea. Perhaps 30,000 tons of oil were spilled in all, killing at least 1,950 birds. Two spills appear to be illegal ship discharges, and two involved double failures of equipment. The author speculates on the potential damage that might occur from the leaky Mesa field off Sutherland.

C-0007-78
FIRST GENERATION DIRECTORY OF OIL SPILLS
Center for Short-Lived Phenomena. 1975.
Cambridge, Massachusetts, Smithsonian Institution, Office of International Programs, 1975.

Oil spills, Sources, Information systems, *Spill directory

A computerized directory of oil and hazardous material spills has been compiled from data in the Smithsonian Center for Short-Lived Phemonena Spill Data Base. Entries include location, source, and cause of the spill; the type and amount of material spilled; and an abstract of the event.

[from Pollution Abstracts 8(5): #77-04367. 1977.]

C-0008-78
OIL TANKER DISASTERS
Gundlach, E.R. 1977.
Environment 19(9):16-27.

Argo Merchant spill, Santa Barbara Channel, Ekofisk blowout, Torrey Canyon, Oil industry, Tankers, Pollution prevention

Petroleum hydrocarbons entering the world's marine environment constitute a major pollution problem. This article reviewed the major oil spills of recent years, and traced the history of tanker spills to early WWII. Predictions for areas of tanker mishaps leading to spills are given, as are predictions of the flagships which will most likely be involved. Planning and implementation of clean-up technology is suggested.

C-0009-78
AN OIL SLICK OCCURRENCE OFF BAFFIN ISLAND
Loncarevic, B.D., and R.K. Falconer. 1977.
Ottawa, Canada. Geological Survey Paper No. 77-1a. (Report of Activities, Part A), p. 523-524. (Project 760039).

Oil slicks, Source identification, Canada

During the 1976 cruise of CSS Hudson to the Arctic an oil slick was observed off the Scott Inlet of Baffin Island. The ship returned 25 days later and conducted an ad hoc sampling program; laboratory analyses are not complete and only preliminary results are available. Natural seepage is suspected as the cause of the slick but 3 possible causes are suggested: natural crude oil, animal (whale?) oil, and refined oil (snowmobile lost through ice, a sunken boat, or a crashed plane?).

C-0010-78
THE EKOFISK BRAVO BLOWOUT
Vanderkooy, N. 1977.
Spill Technology Newsletter 2(3):15-25.

Ekofisk blowout, Spill containment, Spill cleanup, Contingency planning

This report describes events leading up to the blowout of well B-14 Ekofisk Bravo, in April 1977, as well as subsequent events. The response of the scientific community is reviewed. An outline of response structure is shown with recommendations and future contingency plans.

C-0011-78
MAJOR OIL SPILLS FROM TANKERS AND BARGES AND OTHER VESSELS IN U.S. WATERS/ANALYSIS OF RECENT TRENDS AND PATTERNS
Young, G.K., L.S. Warner, and R.U. Jettmar. 1977.
Final Report 1976-1977, EQ-517614239, Contract EQ7AD239. 30 p.

Oil spills, Statistical analysis, Tankers, Barges, US

This report is an investigation of oil spills during the winter of 1976-1977 and provides a comparison with spills since 1969.

[from Government Reports Announcements 77(19): #PB-268 515/4GA. 1977.]

2. MONITORING

C-0012-78
CONTINUOUS WAVE LASERS DETECT POLLUTION IN WATER. DEVELOPED BY RESEARCHERS AT REMOTE SENSING CENTER
Anon. 1976.
University and the Sea 9(6):8-9.

Monitoring, Detection, Remote sensing, Coasts, Lakes, Bays, Rivers, USCG, *Continuous wave laser

Funded by the US Coast Guard, researchers at Texas A&M University's Remote Sensing Center have developed a laser scanner that will be used to detect oil pollution and sediment content in bays, rivers, lakes and along coasts. The device can be programmed to detect only oil, is effective in nearly any kind of weather, and can be permanently mounted in structures above the body of water to be monitored.

C-0013-78
OIL SPILL DETECTOR (product information)
Anon. 1977.
Offshore 37(11):144.

Monitoring, Petroleum products, Detection, Oil spills, Equipment, *Oil sensor

This scanning oil sensor monitors a strip up to 150 m (500 ft) long across water to detect floating oil. When oil is found, an alarm sounds. It is not affected by debris, waves, changes in water level or infrared sources.

C-0014-78
OIL SPILL MARKER (product information)
Anon. 1977.
Offshore 37(11):140.

Monitoring, Oil slicks, Drift, Movement, Equipment, *Buoy

This buoy is designed to drift at the same rate as an oil spill. It transmits a signal so that the spill location is always known. It may be deployed by ship, airplane, or helicopter.

C-0015-78
SIGNIFICANCE OF LOW-MOLECULAR-WEIGHT HYDROCARBONS IN MARINE WATERS
Brooks, J.M., and W.M. Sackett. 1977.
Proceedings of the 7th International Meeting on Organic Geochemistry, 1975. R. Campos and J. Gon (eds.). Madrid, Revista Española de Micropaleontologia. 1977. p. 455-468.

Monitoring, Hydrocarbons, Oceans, Mexico (Gulf of), Offshore production

Thousands of determinations of dissolved hydrocarbons in surface water for 5,000 miles of cruise tracks in the Gulf of Mexico have been made using a shipboard "sniffer" system. Surface water analyses show up to 6 orders of magnitude higher levels of C_1 to C_5 saturated hydrocarbons than open ocean surface water. In almost all cases these high concentrations are attributable to petroleum production operations as many as 10 miles distant, suggesting that saturated low-molecular-weight hydrocarbons are very sensitive indicators of man-derived petroleum pollution.

C-0016-78
REMOTE WATER MONITORING SYSTEM
Grana, D.C., and D.P. Haynes. 1977.
US Patent Application SN-821681.

Monitoring, Sampling, Chemical analysis, Patent, Design-engineering, *Remote operation

The system described integrates the functions of sampling, sample preservation, sample analysis, data transmission, and remote operation. One or more sampling units contain several sample chambers where each sample is analysed by an electrochemical sensor. Data is transmitted to a remote sending and receiving station, and samples remain in their chambers until collected for further laboratory analysis.

[from Scientific and Technical Aerospace Reports 15(19): #N77-28563. 1977.]

C-0017-78
STRATEGIES FOR MARINE POLLUTION MONITORING (book review).
Hamilton, E.I. 1977.
Marine Pollution Bulletin 8(5):118.

Monitoring, Chemical analysis, Hydrocarbons, *Book review

The author reviews the book Strategies for Marine Pollution Monitoring [E.D. Goldberg (ed.). London, John Wiley, 1976.x + 310 p.] and expresses his disappointment in finding no clear statements of strategies. Analysis of petroleum hydrocarbons is mentioned with emphasis on the need for standard methods especially for carcinogenic aromatic hydrocarbons. The reviewer delivers other specific criticism but praises the book for its usefulness and emphasis on the need for improved methods of analysis and superior laboratories.

C-0018-78
DEVICE FOR INDICATING LIQUID, INSOLUBLE FOREIGN LAYERS ON OTHER LIQUIDS
Heidenreich, R. 1977.
German Offenlegungsschriften (unexamined patent application) 2,559,233

Monitoring, Detection, Oil spills, Equipment, Design-engineering, Patent, *Alarm device

An alarm device for detecting floating oils and hydrocarbon fuels consists of a buoy with a light upper section carrying 2 electrodes, and a weighted lower section. The presence of oil dissolves an oil-soluble glue used to keep the electrodes in contact, and when the contact is interrupted, an alarm is triggered.

[from Chemical Abstracts 87(14): #106562w. 1977.]

C-0019-78
THE MEASUREMENT OF OIL IN DISCHARGES
Nichols, J.A., and H.D. Parker. 1977.
The Separation of Oil from Water for North Sea Operations.
Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt
University, 1977. p. 37-45. Proceedings of Seminar, June 22-23,
1976.

Monitoring, Oil discharges, Wastewaters, Analytical techniques, Sampling, Legislation, UK

Legislation which would enforce the continuous monitoring of oily discharges into the sea is briefly reviewed, and the physical requirements of continuous oil-in-water monitoring equipment are given. Included is a brief survey of existing laboratory analysis, field sampling, and monitoring techniques.

C-0020-78
OIL-IN-WATER CONTENT MONITOR DEVELOPMENTAL PROGRAM SUMMARY
Skewes, R.L. 1977.
Final Report No. USCG-D-28-77. 71 p. (Supercedes Report No.
USCG-D-188-75, AD-A022 960).

Monitoring, Detection, Equipment, Reclamation, Sampling

Feasibility studies of three concepts for oil-in-water content monitors are presented: 1) oil fluorescence total luminescence scanning; 2) small angle forward light scattering; and 3) light scattering at 45, 90, and 135 degrees and turbidity at 0 degrees. "The breadboard devices described are capable of linear monitor response to known oil mixtures over the range of 0-400 ppm with a maximum error of +15% (excluding Bunker 'C')." Monitor designs, modifications, and individual contractor test program results are presented.

[from Government Reports Announcements 77(19): #AD-A041 267/6GA. 1977.]

C-0021-78
A PRELIMINARY TEST OF A GOVERNMENT-OWNED LOCAL AREA OIL ON WATER
SURVEILLANCE SYSTEM
White, J.R. 1976.
Final Report, CGR/DC-9/76; CG-D-121-76. 70 p.

Monitoring, Oil slicks, Detection, Surveillance, *Oil-on-water

A field test of 3 fixed site, oil-on-water point sensors was conducted in New Hork Harbor. Determined were such items as number of alarms for various threshold levels and time durations, effects of tidal fluctuations, effects of oil background levels, and sensor reliability. To be operationally desirable, the sensors in a surveillance system must initiate an alarm in one circumstance only, i.e., a surface oil film large enough to warrant cleanup, preventative measures, or legal action.

[from Government Reports Announcements 77(17): AD-A040 541/5GA. 1977.]

3. REMOTE SENSING

C-0022-78
PROCEEDINGS OF THE 2ND CONFERENCE ON ENVIRONMENTAL QUALITY SENSORS
Environmental Protection Agency. 1976.
EPA-600/9-76-031, PB-264 183/5. 779 p. Held at Las Vegas, Nevada, 10-11 October 1973.

Remote sensing, Contaminants, Oil spills, Monitoring, Environmental effects

The papers presented covered such topics as: aircraft, satellite, and land based remote sensing systems for monitoring and identifying pollutants in air, water, and on land, remote sensing techniques, environmental impact assessment, and oil and hazardous material spills identification. Environmental monitoring requirements of the EPA regions were also addressed.

[from Scientific and Technical Aerospace Reports 15(16): #N77-25659. 1977.]

C-0023-78
SUMMARY EVALUATION OF THE OFFSHORE TARGET DETECTION CAPABILITIES OF APS-94D AND COR RADAR SYSTEMS
Estes, J.E., and S.P. Kraus. 1976.
Final Report, May-July 1976, AD-A036245, USCG-D-125-76, Contract DOT-CG-63898-A. 120 p.

Remote sensing, Natural seepage, USCG, California, *Radar systems

Imagery was interpreted from a USCG flight test of an APS-94D real aperture and coherent-on-receive (COR) synthetic aperture radar conducted in three locations of southern and coastal California. Target detection capabilities and resolution characteristics of the 2 systems were evaluated. Natural seep oil slicks and man-made targets were included in the analysis.

[from Scientific and Technical Aerospace Reports 15(19): #N77-28379. 1977.]

C-0024-78
ENERGETICS OF THE LIDAR IN REMOTE DETECTION OF OIL FILMS ON SEAWATER
Gurevich, I. Ya., and K.S. Shifrin. 1977.
Akademiia Nauk SSSR. Bulletin. Atmospheric and Oceanic Physics Series 12(8):527-529.

Remote sensing, Oil slicks, Seawater, *Lidar energetics

An estimate is made of the energy entering the input of a lidar receiver system, utilizing a CO_2 laser, during remote sounding of the sea. It is found that the energy entering the input decreases with an increase in wind speed from 2 to 5 m/s during nadir ranging, but sharply increases during ranging at an angle of 20 degrees. An example is given which allows estimation of the ranging height from which an oil slick on the sea can be detected with a CO_2 lidar system.

[from Pollution Abstracts 8(5): #77-04268. 1977.]

C-0025-78
THE U.S. ENVIRONMENTAL PROTECTION AGENCY PROGRAM OF ENVIRONMENTAL REMOTE SENSING FROM AIRCRAFT
Melfi, S.H. 1977.
Annual Symposium on the Analytical Chemistry of Pollutants, 7th, [1977?]. 2 p.

Remote sensing, Oil spills, Spill cleanup, EPA, *Remote sensing systems

Systems and techniques described include passive imaging systems such as photography, thermal and multispectral scanners, and active laser systems for remote measurements of atmospheric aerosols and molecules and remote sensing of water quality parameters. Oil spill location and documentation, and spill containment and cleanup are among the applications of these systems.

[from Pollution Abstracts 8(5): #77-04883. 1977.]

4. SAMPLING

C-0026-78
HYDROCARBONS IN CORES OF NORTHWESTERN ATLANTIC COASTAL AND CONTINENTAL MARGIN SEDIMENTS
Farrington, J.W., N.M. Frew, P.M. Gschwend, and B.W. Tripp. 1976.
Estuarine and Coastal Marine Science 5(6):793-808.

Sampling, Hydrocarbons, Sediments, Chemical analysis, Chromatography, Massachusetts, *Buzzards Bay

Concentrations and composition of hydrocarbons found in sections of a core sample from Buzzards Bay, Massachusetts, are reported. Sources and distribution of hydrocarbons in the surface sediments are discussed.

C-0027-78
THE POLLUTION OF SEAWATER IN NAGASAKI BAY IN SUMMER, 1975 [English summary]
Miyahara, S., and H. Ohno. 1976.
Bulletin of the Faculty of Fisheries, Nagasaki University No. 41: 21-24.

Sampling, Seawater, Petroleum products, Chemical analysis, *Nagasaki Bay

Sea-water from the surface layers of coastal water in Nagasaki Bay was analyzed for twelve items. "It seemed that the sea-water was polluted by petroleum or the like and the pollution was heavier at the entrance of the bay rather than at the inner and outer stations of the bay."

C-0028-78
OIL POLLUTION OF SURFACE WATERS OF SOME REGIONS OF THE MEDITERRANEAN SEA [in Russian]
Sheremet'ev, V.A., G.A. Doroshenko, and B.T. Demin. 1976.
Morskie Gidrofizicheskie Issledovaniia, No. 3:154-161.

Sampling, Behavior, Fate, Movement, Sea surface, Mediterranean Sea

Shipboard investigations were made during October-November 1974 of the transport and accumulation of oil pollutants in the Mediterranean Sea. The connection between oil pollution fields and the hydrological characteristics of the Sea are analyzed.

[from International Aerospace Abstracts 17(19): #A77-40806. 1977.]

C-0029-78
COMPARISON OF TWO METHODS FOR OIL AND GREASE DETERMINATION
Short, J.W., S.D. Rice, and D.L. Cheatham. 1976.
Assessment of the Marine Arctic Environment: Selected Topics. D.W. Hood and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 451-462. (Occasional Publication No. 4).

Sampling, Chemical analysis, Detection, WSF, Crude oil, Fuel oil, *Method comparison

Comparison of a gravimetric method and a spectrophotometric method of determining water-soluble fractions of crude oil indicates that the gravimetric method is inadequate for anything but grease determination. Infrared spectrophotometry was 100% effective in determining levels of grease, crude oils, and No. 2 fuel oil.

C-0030-78
MUTAGENIC POTENTIAL OF PETROLEUM BYPRODUCTS IN CHESAPEAKE WATERS
Voll, M.J., J.D. Isbister, L.I. Isaki, and M.D. McCommas. 1977.
Maryland Water Resources Research Center. Technical Completion Report, TR-39, W77-07606, OWRT-A-034-MD(1). Contract DI-14-34-0001-6021. 41 p.

Sampling, Petroleum products, Seawater, Sediments, Biodegradation, Chesapeake Bay, *Mutagenic substances

"Chesapeake Bay water and sediment samples from an oil polluted area (Colgate Creek) and a relatively non-polluted area (Eastern

Bay) were assayed by the Ames bacterial system for the presence of mutagenic substances." Organic extracts and/or untreated samples were assayed. Results suggest the presence of mutagenic substances in Colgate Creek water and sediment.

[from Government Reports Announcements 77(17): #PB-267 020/6GA. 1977.]

5. ANALYSIS

C-0031-78
QUANTIFICATION OF WATER-SOLUBLE GASOLINE FRACTIONS USING A RADIOISOTOPIC STANDARD WITH DIRECT AQUEOUS INJECTION-GAS CHROMATOGRAPHY
Berry, W.O., and P.J. Stein. 1977.
Bulletin of Environmental Contamination and Toxicology 18(3): 308-316.

Chromatography, Gasoline, Chemical analysis, WSF

A new gas liquid chromatography technique was developed to determine the amounts of individual water-soluble gasoline fractions present in aqueous solutions. The technique allows direct aqueous injection of water samples without the problems connected with solvent extraction techniques, and results in more accurate quantification.

C-0032-78
ASSAY OF DETERGENT RESIDUES IN FRESHWATER, SEA WATER, AND WASTE WATERS: METHOD OF EXTRACTION AND CONCENTRATION OF SURFACTANTS BY ADSORPTION ON LIQUID-LIQUID INTERFACE [in French]
Clanet, F., and J.-F. Viller. 1976.
Water Research 10(9):829-832.

Surfactants, Extraction, Wastewaters, Seawater, Freshwater, Analytical techniques

"The surfactant adsorption properties on greases and oils are used for extraction and concentration of surfactants from waters and wastes. The recovery rate is 97.1% with vaseline oil in the conditions exposed....Different techniques are developed."

[from Selected Water Resources Abstracts 10(15): #W77-07591. 1977.]

C-0033-78
POLYCYCLIC AROMATIC HYDROCARBONS IN THE ENVIRONMENT; CHARACTERIZATION BY CAPILLARY GC-MS AND LOW VOLTAGE MASS SPECTROMETRY
Giger, W. 1977.
Annual Symposium on the Analytical Chemistry of Pollutants, 7th, [1977?]. n.p.

PAH, Analytical techniques, Sediments, Lakes, Rivers

An analytical scheme to isolate PAH from environmental samples in which they occur at parts-per-million concentrations is described. The method consists of gel filtration and adsorption chromatography, glass capillary gas chromatography, directly coupled mass spectrometry (MS), and probe distillation and low voltage MS.

[from Pollution Abstracts 8(5): #77-04259. 1977.]

C-0034-78
RATE OF MICROBIAL TRANSFORMATION OF POLYCYCLIC AROMATIC HYDROCARBONS: A CHROMATOGRAPHIC QUANTIFICATION PROCEDURE
Herbes, S.E., L.R. Schwall, and G.A. Williams. 1977.
Applied and Environmental Microbiology 34(2):244-246.

Chromatography, PAH, Bacteria, *Microbial transformation

Microbial transformation products of ^{14}C-labeled PAH can be isolated and quantified with this newly developed chromatographic procedure. Measurements were made of the transformation rates of naphthalene, anthracene, benz(a)anthracene, and benz(a)pyrene by a mixed bacterial population. Previous techniques were unable to detect very slow or incomplete transformations that this procedure quantifies.

C-0035-78
ORGANIC MARKER COMPOUNDS
Hertz, H.S. 1977.
Annual Symposium on the Analytical Chemistry of Pollutants, 7th, [1977?]. 1 p.

Contaminants, Chemical analysis, Chromatography, *Marker compounds

The amount of oil in an environmental sample can be quantified through the use of a compound or series of compounds which is employed as an internal or external standard. A common internal standard is used to relate independent analyses of an environmental sample and a sample of the oil (external standard). Representative peaks in chromatograms of the oil can be directly compared with peaks in the extract of an environmental sample, and the wt. percent of oil in the sample can be calculated using an equation which is described.

[from Pollution Abstracts 8(5): #77-04877. 1977.]

C-0036-78
RAPID METHOD FOR CHARACTERIZATION OF HEAVY PETROLEUM FRACTIONS
Hodgin, J.C., M.A. Kaiser, J.A. Lubkowitz, and L.B. Rogers. 1977.
Journal of Chromatography 135(2):514-520.

Chromatography, Petroleum products, Source identification

Results from this study show the feasibility of obtaining rapid "fingerprints" of small petroleum product samples through gel permeation chromatography. LiChrospher and LiChrosorb were used to obtain profiles of molecular-weight distributions of some petroleum crudes, pitches, and asphaltenes. The elution time was less than 30 min for less than 16 μg of each sample.

C-0037-78
INSTRUMENTAL METHODS OF ANALYSIS FOR WATER POLLUTION CONTROL [in Japanese]
Kitazato, H. 1976.
Sekiyu Gakkai Shi 19(7):573-577.

Analytical techniques, Chemical analysis, Pollution control

"A review, with 8 references."

[from Chemical Abstracts 87(18): #140866h. 1977.]

C-0038-78
IDENTIFYING SOURCE OF PETROLEUM BY INFRARED SPECTROSCOPY
Lynch, P.F., and C.W. Brown. 1976.
Chemistry of Petroleum Processing and Extraction I. New York, MSS Information Corporation, 1976. p. 227-237.

Source identification, Spectroscopy, Crude oil, Fuel oil, Petroleum products

Infrared spectra measurements have been taken of over 50 samples of crude oils, fuel oils, and other petroleum products. Each sample had characteristic bands in the 650 to 1200 cm^{-1} spectral region, which can be used in source identification. Computer analysis of the ratios of known to unknown absorptives of 21 selected bands is used in the matching process.

[from ERDA Energy Research Abstracts 2(17): #40992. 1977.]

C-0039-78
PROBLEM DEFINITION STUDIES ON POTENTIAL ENVIRONMENTAL POLLUTANTS. IV. PHYSICAL, CHEMICAL, TOXOLOGICAL, AND BIOLOGICAL PROPERTIES OF BENZENE; TOLUENE; XYLENES; AND PARA-CHLOROPHENYL METHYL SULFIDE, SULFOXIDE, AND SULFONE
Miller, T.A., D.H. Rosenblatt, J.C. Dacre, J.G. Pearson, and R.K. Kulkarni. 1976.
Technical report, TR-7605. 95 p.

Contaminants, Petroleum products, Environmental effects, Toxicity, Analytical methods

A summary of the following information is provided for the title pollutants: physical/chemical properties; analytical methods; mammalian toxicology; environmental considerations for wildlife, birds, fish, reptiles, amphibians, invertebrates, microorganisms, and plants; and existing standards.

[from Government Reports Announcements 77(17): #AD-A040 435/OGA. 1977.]

C-0040-78
ISOLATION OF NATURAL SURFACE-ACTIVE MATERIALS OF CRUDE OILS BY ADSORPTION CHROMATOGRAPHY
Milley, J. 1977.
Journal of Chromatography 139(1):135-140.

Surfactants, Crude oil, Chromatography, Chemical analysis

In order to isolate natural surfactants of crude oils, a traditional open-column adsorption chromatographic method is developed using Kieselguhr as column packing. Classification of the crudes is based on the interfacial activity of fractions, obtained by measuring the interfacial tension of benzene solutions against distilled water. Molecular-weight measurements and IR spectroscopy are used to evaluate the chemical properties of crude fractions.

[from Chemical Abstracts 87(18): #138312f. 1977.]

C-0041-78
THE USE OF PROCESS LIQUID CHROMATOGRAPHY IN THE ANALYSIS OF INDUSTRIAL STREAMS
Mowery, R.A., Jr. 1977.
Analysis Instrumentation. Proceedings of the Annual Analysis Instrumentation Symposium, Vol. 15:119-130.

Chemical analysis, Chromatography, Oil industry, Petrochemicals

Preliminary studies related to the petroleum and petrochemical industries show the feasibility of process liquid chromatography for the separation of many chemical species, including hydrocarbons.

[from Chemical Abstracts 87(18): #138309k. 1977.]

C-0042-78
DOSAGE DES HYDROCARBURES DANS LES EAUX [in French]
Ranchet, J., and P. Clement. 1977.
Techniques et Sciences Municipales et Revue L'eau 72(1):23-27.

Hydrocarbons, Analytical techniques, *Carbon tetrachloride

Three methods of determining hydrocarbons in water by carbon tetrachloride were studied and compared. The methods are API, P. Chambon, and AFNOR T 90-203, the last being best suited to surface water analysis. Results are assessed by IR spectrography.

[from Pollution Abstracts 8(5): #77-04190. 1977.]

C-0043-78
COORDINATION POLYMERS AS ADSORBENTS AND STATIONARY PHASES IN GAS CHROMATOGRAPHY. I. POLY[CHROMIUM(III)DIPHENYLPHOSPHINATE]
Szczepaniak, W., and J. Nawrocki. 1977.
Journal of Chromatography 138(2):337-345.

Chromatography, Hydrocarbons, Adsorption

The use of the title agent as a selective packing for gas chromatography is discussed. The coordination polymer reacts specifically with hydrocarbons containing a π-bond. Calculations of the thermodynamic effects of the sorption of various compounds were done, and a series of chromatographic separations of test mixtures of hydrocarbons were conducted.

[from Chemical Abstracts 87(18): #145378k. 1977.]

C-0044-78
DEVICE FOR THE SAMPLING AND TREATMENT OF THE ELUATE DURING THE MICROCHROMATOGRAPHIC SEPARATION OF ORGANIC SUBSTANCES [in Russian]
Zakupra, V.A., and V.A. Kozak. 1977.
Zavodskaya Laboratoriya Zhurnal po Analiticheskoi Khimii, Fizicheskim, Matematicheskim i Mekhanicheskim Metodam Issledovaniya Materialov 43(6):670-672.

Hydrocarbons, Chromatography, *Coal tar distillates

A glass apparatus used in chromatography of hydrocarbons and coal for distillates is described. The apparatus collects small amounts (0.11-0.15 g) of eluates with bp > 150° in liquid chromatography.

[from Chemical Abstracts 87(18): #138129b. 1977.]

6. SOURCE IDENTIFICATION

C-0045-78
THE FLUX OF LIGHT HYDROCARBONS INTO THE GULF OF MEXICO VIA RUNOFF
Brooks, J.M. 1977.
Marine Pollutant Transfer. H.L. Windom, and R.A. Duce (eds.).
Lexington, MA, Lexington Books, D.C. Heath and Company, 1977.
p. 185-200.

Source identification, Hydrocarbons, Production, Mexico/Gulf of, Mississippi River

Light gaseous hydrocarbons (methane through pentanes) are sensitive indicators of petroleum pollution. Natural processes cannot account for the occurrence of light hydrocarbons in the Gulf of Mexico, and thus they must enter chiefly from man-derived sources, river runoff, and/or across the sea/air or sea/sediment interface. In particular, light hydrocarbons in the Mississippi River originate predominately from petroleum and petrochemical activities. Significant impacts on coastal waters are evidenced by hydrocarbon anomalies seen from 16-32 km (10-20 mi) off port and up to 80 km (50 mi) off the Mississippi River.

C-0046-78
IDENTIFICATION OF OIL SLICKS BY INFRARED SPECTROSCOPY
Brown, C.W., P.F. Lynch, and M. Ahmadjian. 1976.
USCG-D-19-77, CGR/DC-5/77, Contract DOT-CG-81-74-1099, Final report
1 Feb 74 — 15 Aug 76.

Source identification, Weathering, Spectroscopy, *Computer analysis

In this study, 85 different oils of all types were "weathered" for two weeks in 2 to 4 weathering grids. A library of weathered oils was compiled from spectral data on approximately 900 weathered oil samples which were digitized and stored in computer data files. These samples were compared to 300 spectra of their unweathered sources by a computer ratio method and the identification technique developed for using infrared spectroscopy with computer analysis proved very useful.

[from Government Reports Announcements 77(18): #AD-A040 975/5GA. 1977.]

C-0047-78
MODE OF OCCURRENCE OF TRACE ELEMENTS IN PETROLEUM AND RELATIONSHIP TO OIL-SPILL IDENTIFICATION METHODS
Filby, R.H., and K.R. Shah. 1976.
Chemistry of Petroleum Processing and Extraction. III. New York,
MSS Information Corporation, 1976. p. 182-205.

Source identification, Crude oil, Chemical analysis, *Trace elements

Fifteen trace elements were measured by thermal neutron activation analysis. Six oils were analyzed and large variations were shown in the trace element contents even within a given oil well. The implications of the results for fingerprinting procedures are discussed.

[from ERDA Energy Research Abstracts 2(17): #41027. 1977.]

C-0048-78
INFRARED ANALYSIS TECHNIQUES FOR OIL IDENTIFICATION
Grizzle, P.L., and H.J. Coleman. 1977.
Bartlesville Energy Research Center, 1977. 24 p.

Source identification, Crude oil, Spectroscopy, Statistical analysis, Weathering

Infrared (IR) absorbance data at 14 frequencies were obtained for 52 crude oils and 52 corresponding topped (distilled through 275°C) crude oil samples. Statistical analysis justifies using 12 of these frequencies for the identification of weathered (topped) crude oils and for unweathered crude oil samples. Fluctuations in the magnitude of the absorbance bands, differentiation of spectrally similar unweathered crudes, and artificial weathering of unweathered samples for comparative purposes are discussed.

[from ERDA Energy Research Abstracts 2(16): #39252. 1977.]

C-0049-78
CHARACTERIZATION AND IDENTIFICATION OF SPILLED RESIDUAL FUEL OILS BY GAS CHROMATOGRAPHY AND INFRARED SPECTROSCOPY
Kawahara, F.K. 1976.
Chemistry of Petroleum Processing and Extraction. III. New York, MSS Information Corporation, 1976. p. 142-163.

Source identification, Fuel oil, Residual oils, Chemical analysis, Petroleum products, Chromatography

The Analytical Quality Control Laboratory has developed the title analytical methods. Four GC techniques and IR procedures can reveal oil identities and approximate ages of spills even when 2 different oils are spilled near the same area at about the same time. Good results have been obtained from a new electron capture detector gas chromatographic method designed for identifying heavier petroleum products.

[from ERDA Energy Research Abstracts 2(17): #40993. 1977.]

C-0050-78

CHARACTERIZATION OF HEAVY RESIDUAL FUEL OILS AND ASPHALTS BY INFRARED SPECTROPHOTOMETRY USING STATISTICAL DISCRIMINANT FUNCTION ANALYSIS
Kawahara, F.K., J.F. Santner, and E.C. Julian. 1976.
Chemistry of Petroleum Processing and Extraction. III. New York, MSS Information Corporation, 1976. p. 164-181.

Source identification, Residual oils, Petroleum products, Statistical analysis, *Infrared spectrophotometry

A combination of infrared spectrophotometry, data treatment, data transformation, and discriminant function analysis through computer assistance has been developed as a highly accurate method of distinguishing between the two title petroleum products. This infrared procedure should enable sample classifications to be made for source identification.

[from ERDA Energy Research Abstracts 2(17): #40994. 1977.]

C-0051-78

THE SOURCES OF OIL CONTAMINATED DISCHARGES ARISING DIRECTLY FROM NORTH SEA OIL OPERATIONS
King, N.J., and T.G. Wilkinson. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 2-14. Proceedings of Seminar, June 22-23, 1976.

Source identification, Tankers, Platforms, Oil terminal, Offshore production, Oil discharges, Contamination, North Sea

Oil contamination from tanker ballast, displacement water from oil storage tanks on production platforms, produced waters, and operational discharges from onshore and offshore terminals, leakage, etc., have been identified as sources of oil pollution in the North Sea. The significance of these discharges relative to the overall marine environment are discussed.

C-0052-78

HYDROCARBON STUDIES IN THE BENTHIC ENVIRONMENT AT PRUDHOE BAY
Shaw, D.G., and L.M. Cheek. 1976.
Assessment of the Arctic Marine Environment: Selected Topics. D.W. Hood and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 425-431. (Occasional Publication No. 4).

Source identification, Hydrocarbons, Sediments, Marine organisms, Chemical analysis, Benthos, Alaska, *Prudhoe Bay

Measurements of aliphatic hydrocarbons collected from the sediments and biota in and around Prudhoe Bay, Alaska, during 1974 indicated that the hydrocarbons were largely or totally of biogenic origins.

B. OIL POLLUTION PREVENTION AND CONTROL

1. CONTAINMENT

C-0053-78
SPILLED OIL-GELLING AGENT
Abe, K., S. Tomita, Y. Morita, K. Terashima, et al. 1977.
Japanese Kokai (unexamined patent application) 76,132,653

Spill containment, Yeasts, Patent, *Gelling agent

Denatured yeast obtained by removal of water-soluble components from yeast and carboxymethylation is used for gelling spilled oil.

[from Chemical Abstracts 87(14): #106566a. 1977.]

C-0054-78
OIL COLLECTOR
Tamano, N. 1977.
Japanese Kokai (unexamined patent application) 77 48,581

Spill containment, Adsorption, Patent, *Collecting agent

An oil collecting agent is produced by coating powdered carbon with organic compounds to give buoyancy and hydrophobicity, then admixing powdered magnetic metal.

[from Chemical Abstracts 87(14): #106631t. 1977.]

2. CLEANUP AND RECOVERY

C-0055-78
CLEAN IT UP WITH A SOCK
Anon. 1976.
Ecolibrium 5(3):2-4.

Spill cleanup, Spill recovery, Design-engineering

Summary not available.

[from Environmental Periodicals Bibliography 6(2): #6:1221. 1977.]

C-0056-78
NOAA SEA GRANT FUNDING AIDS OIL SPILL RESEARCH (news brief)
Anon. 1977.
Sea Technology 18(8):26.

Spill recovery, Adsorption

"Joe Turbeville, a physicist at the University of South Florida, is in the final year of a two-year, $36,000 grant from NOAA's Sea Grant Program to study the possibility of building small boats capable of being shipped anywhere in the world to clear oil spills." The 7.3m (24 ft) prototype model uses magnetic ferrofoam pads to adsorb the oil. Estimated recovery rate is 9,100 L/hr/kn (2,400 gal/hr/knot) for lighter crudes and diesel oil.

C-0057-78
OIL SKIMMER (product information)
Anon. 1977.
Offshore 37(11):144-145.

Spill cleanup, Spill recovery, Skimmers, Equipment

This device is designed for use on boats, docks, drilling platforms, etc., and is capable of removing oil ranging from very thin to thick. It provides flow volumes up to 400 L/min (105 gpm) and can take 20% air without air locking.

C-0058-78
OIL SPILL BOAT DEVELOPED IN FINLAND
Anon. 1977.
Petroleum Engineer International 49(13):14.

Booms, Spill containment, Ships, Design-engineering, Equipment

A boat, Vator 18T, has been designed in Finland to provide defense against spilled oil. The craft can be deployed at speeds up to 30 knots and, once upon the scene, can launch up to 200 m (650 ft) of boom at about 9 m (30 ft) per minute.

C-0059-78
PORTABLE OIL SKIMMER (product information)
Anon. 1977.
Journal Water Pollution Control Federation 49(9):755a.

Skimmers, Spill recovery, *Product information

This oil skimmer weighs 20.4 kg (45 lbs) and will remove 30.3 L (8 gal) of oily waste an hour from contaminated pools, streams, catch basins, sumps, tanks, or other areas. The product is available in lengths of 1.5-2.4 m (5-8 ft), and has a 5.1 cm (2 in) wide metal belt. For further information write to Aerodyne Development Corporation, 29085 Solon Road, Cleveland, OH 44139.

C-0060-78
PORTABLE SKIMMER FOR QUICK RESPONSE (product information)
Anon. 1977.
Petroleum Engineer 49(11):10-11.

Spill recovery, Booms, Skimmers

Shell Development Co.'s transportation research and engineering department has designed a spilled oil cleanup kit (SOCK) of portable components able to fit on work boats and supply boats. The components are: Sock (flexible boom-skimmer); floating frame; crane; pump and power unit; container; towable bags (for temporary storage).

C-0061-78
21 'MINISKIMMERS' DELIVERED BY MARCO FOR OFFSHORE, HARBORS (product information)
Anon. 1977.
Sea Technology 18(9):44.

Skimmers, Spill recovery, *"Miniskimmer"

Marine Construction and Design Co. (MARCO) produces the Komara "Miniskimmer," a portable, circular disc-type oil skimmer. Designed for rapid deployment, two men can easily handle the 1.07 m (42 in) diameter, 49.9 kg (110 lb) unit. It can be used for small spill recovery or early-response to larger spills in waves and calm waters.

C-0062-78
THE VIKOMA SYSTEM FOR CLEARING OIL SPILLS AT SEA (product information)
Anon. 1977.
Clean Air 11(1):18-19.

Booms, Skimmers, Spill Cleanup, Equipment

The Vikoma System for oil pollution control at sea consists of the Vikoma Sea-Pack — a 488 m boom with its own self-contained development system; the Vikoma Sea Skimmer — for use in deep water; and the Komara Mini Skimmer — for use in shallow areas. Details are given.

C-0063-78
A ZERO-RELATIVE-VELOCITY BELT SKIMMER, STAGE II — CONFIRMING TESTS AND PROTOTYPE DESIGN
Ayers, R.R., and J.M. Ward. 1977.
Final Report July 75-Sept 76, USCG-D-23-77, Contract DOT-CG-42229-A. 152 p.

Skimmers, Spill recovery, Equipment

Preliminary tests have been performed on a 12.2 m (40-ft long) prototype skimming vessel that uses twin floating sorbent belts to recover spilled oil in 6-8 knot currents. Oil recovery rates up to 2300 L/min (600 gpm) are possible. A 1/8-scale model of the catamaran vessel that supports the oil recovery apparatus was also tested.

[from Government Reports Announcements 77(19): #AD-A041 416/9GA. 1977.]

C-0064-78
AGENTS, METHODS AND DEVICES FOR AMELIORATION OF DISCHARGES OF HAZARDOUS CHEMICALS ON WATER
Bauer, W.H., and J.J. Bulloff. 1975.
Report CG-D-38-76. 285 p. NTIS No. ADA-024 221.

Spill cleanup, Pollution control, *Chemical agents, *Hazardous chemicals

Chemical agents and methods were identified and evaluated for 30 representative hazardous chemicals on water. It was concluded that the use of chemical agents is feasible for 29 of the 30 chemicals selected. Agents found to be the most advantageous were sorbents, ion exchangers, diluents, neutralizers, collectors, precipitants, reductants, oxidizers, and ultrafiltration membranes.

[from Selected Water Resources Abstracts 15(18): #W77-08910. 1977.]

C-0065-78
DEVELOPMENT OF A STREAMING-FIBER OIL SPILL CONTROL SYSTEM, STAGE II
Beach, R.L., D.W. Durfee, and R.J. Powers. 1976.
Final Report 26 Sept 75-22 Nov 76, USCG-D-4-77, Contract DOT-CG-40217-A. 150 p.

Spill containment, Models, Equipment, *Streaming-fiber system

A large-scale model of the streaming fiber oil spill control system has been developed by Seaward International, Inc. It has been tested successfully under simulated field conditions.

[from Government Reports Announcements 77(19): #AD-A041 315/3GA. 1977.]

C-0066-78
METHODS FOR REMOVAL AND CLEANUP OF OIL SPILLS [in Chinese]
Chen, H-C. 1977.
Chung-Kuo Shui Ch'an 292:14-16.

Spill cleanup, Spill disposal, Biodegradation, Adsorption, Dispersions

A review is presented covering biodegradation, mechanical collection, physical sinking, adsorption, combustion, and chemical dispersion. No references are given.

[from Chemical Abstracts 87(18): #140862d. 1977.]

C-0067-78
OIL SPILLS: THE STRATEGY OF RECOVERY
Conrad, J.M. 1976.
University of Massachusetts, Amherst. Preliminary report. Grant A-087. 38 p.

Spill cleanup, Models, Contingency planning, Offshore development, Georges Bank, Massachusetts

A model for determining the optimal location of recovery resources is developed and applied to coastal Massachusetts. Nine hypothetical situations were constructed relating to possible petroleum finds on Georges Bank and onshore developments in southeastern Massachusetts. The location of recovery packages was determined for each situation, with priority areas selected at Cape Cod, Martha's Vineyard, Nantucket, Boston Harbor, and Plymouth.

C-0068-78
CONTROLLABLE SORBENT BROADCASTER
Der, J.J. 1976.
Denver, CO, Environmental Protection Agency, 1976. 14 p.

Spill cleanup, Absorption, *Sorbent broadcaster

According to the patent application, this device broadcasts oil sorbent material at a controlled rate uniformly over an oil slick. A rotating cylinder of wire mesh has an endless belt which contains compartments filled with the sorbent materials.

[from ERDA Energy Research Abstracts 2(17): #40984. 1977.]

C-0069-78
OIL POLLUTION PRECAUTIONS ON KENT COAST (news brief)
Dixon, T.R. 1977.
Marine Pollution Bulletin 8(9):195.

Spill cleanup, Pollution control, England, *Surface film-forming chemicals

The Kent County Council has decided to use surface film-forming chemicals in future shoreline spill cleanup procedures. The chemicals restrict the lateral spread and penetration of oil by increasing its surface tension. This method will reduce the dependence upon more harmful mechanical means on sandy beaches and dispersants used manually and mechanically offshore, inshore, and on the beaches.

C-0070-78
MARINE AND INDUSTRIAL OIL/WATER SEPARATION
Gabriel, J.C., and G. Parry. 1977.
Filtration and Separation 14(3):253-254, 256.

Spill cleanup, Pollution prevention, Equipment, Oil-water separation, Industries

Spill cleanup equipment and methods for preventing spills are discussed.

[from Chemical Abstracts 87(18): #140720f. 1977.]

C-0071-78
NEW OIL ABSORBERS. KAPOK FIBERS [in Japanese]
Government Industrial Research Institute. 1977.
JITA Nyusu 90:18.

Spill cleanup, Absorption, *Kapok fiber

Kapok fiber used for oil spill cleaning was found to be inert to oil. It is reported that the fiber has a natural water repelling property and a density of 0.04-0.05 g/cm^3. Kapok fiber absorbed 59.7 g heavy oil/g fiber while polypropylene fiber absorbed 27.5 g/g fiber.

[from Chemical Abstracts 87(18): #140655p. 1977.]

C-0072-78
THERMOPLASTIC RESIN ADSORBENT FOR REMOVING OILS FROM WATER
Itano, Y., A. Ohmori, and Y. Ohta. 1976.
Japanese Kokai (unexamined patent application) 76 67,275

Spill cleanup, Adsorption, Patent

A thermoplastic resin containing a foaming agent is melted and extruded in a way that forms innumerable discontinuous and parallel cracks along the surface. Further treatment of the material by heating and rolling forms an oil adsorbent which in tests adsorbed 28 g heavy oil/g adsorbent.

[from Chemical Abstracts 87(16): #122450p. 1977.]

C-0073-78
OIL COLLECTOR
Kunitomo, Y., and T. Saida. 1977.
Japanese Kokai (unexamined patent application) 77 58,089

Spill cleanup, Absorption, Patent, *Plant fiber mat

"Plant fiber laminate in a desired thickness is covered with nets on both sides, placed with longer fibrous material on one side, and needle-punched from the other side." The experimental mat absorbed heavy oil 8.47 g/g (0.74 g/ml).

[from Chemical Abstracts 87(18): #141082m. 1977.]

C-0074-78
AQUA DOME CANOPY PUTS THE PROBLEM OF OFFSHORE OIL LEAKS UNDER COVER
Logan, C.F. 1977.
Offshore 37(11):111-112.

Equipment, Spill cleanup, Spill recovery, Santa Barbara Channel, *Submerged canopies

The submerged canopy was put into use on the 1969 Santa Barbara Channel oil spill. Seven years later, 9 of 12 canopies are still in use. Canopies range from a diameter of about 1 m to 33 m. The plastic canopy uses the density differential concept to force floating contaminants to the surface through air lift tubes.

C-0075-78
OIL SPILL CLEANUP IN THE BEAUFORT SEA: ANOTHER VIEWPOINT
Lowthian, J.W. 1977.
Spill Technology Newsletter 2(3):33-52.

Spill cleanup, Spill recovery, Ice, Canada, Beaufort Sea, *Polar pack ice

In response to an earlier article [O'Rourke, Spill Technology Newsletter 2(1)] in which an optimistic view of oil spill cleanup capabilities was presented, this article provides additional cautionary information about the Arctic environment. An elaborate and detailed description of the ice pack, the action of oil and its effects on ice melting, and the probability of success of various kinds of cleanup methods are presented and critically examined.

C-0076-78
THE CLEANUP OF OIL SPILLS FROM UNPROTECTED WATERS
Milgram, J. 1977.
Oceanus 20(4):86-94.

Oil spills, Spill cleanup, Booms, Skimmers, Pollution prevention, Legislation

The author categorizes oil spills in 3 ways: chronic, such as at refineries and ports; intermediate-sized spills in protected waters; and major spills in unprotected waters. The cleanup of major spills in open waters is discussed in terms of the dynamics of cleanup devices and 5 elements crucial to effective cleanup systems. Recommendations are made for government policy concerning pollution prevention and research.

C-0077-78
METHOD OF DISPERSING OIL IN WATER
Osborn, P.G., P.F. Nicks, and M.G. Norton. 1976.
U.S. Patent 3,996,134

Spill cleanup, Dispersants, Oil slicks, Patent, *Resin

This invention provides an efficient method of dispersing oil slicks. It comprises contacting the oil and water with an alkyd resin in which one component of the resin is the residue of a water-soluble polyalkylene glycol, such as polyethylene glycol.

[from Selected Water Resources Abstracts 10(16): #W77-08332. 1977.]

C-0078-78
OIL COLLECTING AGENT FROM OIL SPILL
Takahashi, M., M. Kida, and G. Kondo. 1976.
Japanese Kokai (unexamined patent application) 76,147,487

Spill cleanup, Patent, *Collecting agent

The title agent is made of a C_{8-18} long chain aliphatic primary amine and a diluent, and is used to collect an oil spill and to prevent spreading of the oil. The agent is nontoxic to marine organisms and in the experiments oil was collected in 15 seconds and remained undiffused after 1 day.

[from Chemical Abstracts 87(18): #140853b. 1977.]

C-0079-78
SPREADING, RETENTION AND CLEAN-UP OF OIL SPILLS
Wilson, M.P., Jr. 1976.
Final report, Contract EY-76-S-02-2756. 130 p.

Spill cleanup, Sources, Statistical analysis, Biodegradation, Dispersions, Pollution prevention

The technology of spill cleanup procedures is reviewed and assessed and research needs are detailed. Spill sources, statistical analysis, barrier technology, natural and forced biodegradation, and natural and chemical dispersion are discussed. Recommended research includes prevention and cleanup.

[from ERDA Energy Research Abstracts 2(17): #40985. 1977.]

C-0080-78
WHAT ARE WE DOING ABOUT OIL SPILL
Wilson, M.P., Jr. 1976.
Maritimes 20(3):7-9.

Spill cleanup, US, Contingency planning, Pollution prevention

The state of preparedness of the United States for the containment and cleanup of oil spills is discussed. Methods of cleaning up spills and their effectiveness are also described.

[from Selected Water Resources Abstracts 15(19): #W77-09553. 1977.]

3. RESTORATION

C-0081-78
MICROBIOLOGY OF SOILS CONTAMINATED WITH PETROLEUM HYDROCARBONS. II. NATURAL REHABILITATION AND RECLAMATION OF SOILS AFFECTED
Odu, C.T.I. 1977.
Institute of Petroleum, IP77-002. 21 p. Technical Paper.

Restoration, Soil, Contamination, Crude oil, Microorganisms, Decomposition, *Nigeria

"Results of changes in the percentage contents of crude oil, microbial counts, organic C, N, and C/N ratios under natural rehabilitation over 2 years in an oil contaminated, sandy, sedimentary well drained soil of the Ogoni area of Nigeria are presented." The oil contamination seemed to promote large increases in microorganisms and C/N ratios. With time, the petroleum hydrocarbons decomposed; microbial populations and C/N ratios decreased; and soil organic C and total N increased.

[from Chemical Abstracts 87(19): #150787x. 1977.]

4. OIL TRANSFER AND TRANSPORT

C-0082-78
ALASKA OIL (news brief)
Anon. 1977.
Audubon 79(5):155-156.

Alaska, Pipelines, Economics, *Accidents

The $9 billion Alaska pipeline was beset with problems from inception to operation. A listing of many of them is given. Fiscal waste and sabotage and accidents are cited as the major ones.

C-0083-78
CONCRETE OIL CONTAINMENT RING GUARDS AGAINST DOCKSIDE SPILLS (news brief)
Anon. 1977.
Sea Technology 18(10):24.

Spill containment, Oil transfer, Pollution prevention, Leakage, Ports, *Containment ring

A containment ring or "sealer bumper," has been designed by Amoco Pipeline Company. It is a 10 cm (4 in) high concrete barrier around the dock perimeter, and is permanently bonded to the concrete surface of the pier. The main function of the containment ring is for oil spill containment.

C-0084-78
JAPANESE SYSTEM DEVELOPED FOR TANKER SPILL SIMULATION (product information)
Anon. 1977.
Sea Technology 18(9):44-45.

*Computer simulation system, Oil transfer, Tankers, Ballast, Pollution prevention

A computerized system to simulate loading/discharge operations for a tanker has been developed by the Japanese steelmaker NKK. Trim control is maintained by regulating cargo oil flow and control of hull longitudinal strength through regulation of the ballast. Programming an accident into the simulation system in a part of the piping system automatically re-routes the cargo oil flow, and permits uninterrupted loading/discharge.

C-0085-78
REVIEW OF ENVIRONMENTAL ISSUES OF THE TRANSPORTATION OF ALASKAN NORTH SLOPE CRUDE OIL
Brown, R.D., and R.M. Helfand. 1977.
EPA-600/7-77-046, PB 270 088. 175 p.

Oil transport, Crude oil, Environmental effects, Pipelines, Tankers, Water quality, Alaska, US, *West coast

The influx of Alaskan and Offshore West Coast oil has created the need to move the oil which exceeds West Coast demands to other areas. Proposals for this movement include Canadian and US pipelines, tanker traffic, and exchanges of oil with foreign countries. The environmental issues center on impacts affecting air and water quality. Water pollution impact is contingent upon the risk of oil spills, probable spill trajectories, and the environmental characteristics of a particular alternative.

C-0086-78
CRUDE OIL DISTRIBUTION SYSTEM: VALDEZ, ALASKA TO MIDLAND, TEXAS (AS PREPARED BY SOHIO TRANSPORTATION COMPANY): MAPS
Bureau of Land Management. 1976.
Draft Environmental Impact Statement Attachment 1. 102 p.

Oil transport, Crude oil, Alaska, US, Environmental effects, EIS

A series of maps outlining proposed routes for a transcontinental pipeline to bring Alaskan crude oil to the eastern US is presented. Geologic and soil hazards, water resources, visual and recreational resources, and the planned use of the pipeline from 1975-1990 are presented graphically.

[from Environment Abstracts 7(7/8): #77-03843. 1977.]

C-0087-78
TANKERS IN U.S. WATERS
Stewart, R.J. 1977.
Oceanus 20(4):74-85.

Oil spills, Leakage, Tankers, Statistics, Oil transport, US

This is a discussion of tanker accidents and accidental spills, and the problem of correctly identifying the potential for accidents. It is difficult to obtain a detailed accounting of American and foreign tanker traffic in US waters. Data on spills is readily available, although there are many errors in coding the information. A discussion of tanker traffic patterns, port calls, oil tonnage, spills, and age of tankers leads to an estimation of future oil tanker accidents.

5. WASTE TREATMENT AND DISPOSAL METHODS

C-0088-78
LAST STAGES OF REFINERY AIR AND WATER CLEAN-UP ARE EXPENSIVE (news brief)
Anon. 1977.
Oil & Gas Journal 75(44):158, 160.

Refineries, Wastewater treatment, Cost analysis, Economics, Water quality

A recent study conducted by Concawe indicates that the last stages of refinery air and effluent cleanup are out of proportion to the expected improvement. Five hypothetical refinery configurations of different complexity but the same crude oil-distillation capacity of 10 million tons/year were selected for the estimates. The 44-page report is available from Concawe, Van Hogenhoucklaan 60, The Hague 2018, The Netherlands.

C-0089-78
VALDEZ OUTFALL LINE IS EARTHQUAKE-PROOF (news brief)
Anon. 1977.
Sea Technology 18(10):24-25.

Ballast, Pipelines, Alaska Coast, Disposal, Treated effluent

A 120 cm (48-in) diameter polyethylene pipe has been installed to carry treated ballast water out to sea. Oily seawater ballast from tankers is pumped ashore at Valdez. After treatment to remove the oil, the water is returned to sea via the pipeline, with diffusers about 73 m (242 ft) below the surface. About 95.2 million L (800,000 bbl) of treated effluent can be discharged daily.

C-0090-78
CONTINUOUS PURIFICATION OF PETROLEUM REFINERY EFFLUENTS — BY BIOLOGICAL OXIDATION AND AERATION BETWEEN STAGES
(Inventor unknown). 1977.
French Patent 2,313,322

Wastewater treatment, Refineries, Activated sludge, Patent

A four-stage activated sludge treatment of petroleum refinery wastes is described. It consists of a sedimentation phase; a stage employing equalization, pH adjustment, coagulation, oxidation, and filtration; a biological treatment stage; and a final stage of tertiary treatment by coagulation/flocculation, filtration, and adsorption on activated carbon.

[from Selected Water Resources Abstracts 10(19): #W77-09422. 1977.]

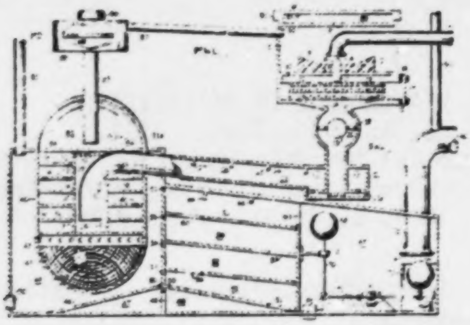
C-0091-78
OIL SEPARATOR DEVICE
Baughcom, E.J., and D.C. Lee, Sr. 1976.
U.S. Patent 3,992,297

Oil-water separation, Bilges, Coalescence, Pollution control, Patent, Equipment

A bilge oil separating system or apparatus includes a float controlled bilge pump for pumping the oil contaminated bilge water from the ship's bilge into a splatter chamber. The oil is coalesced and moves with the water down into a diffuser and then into an upward extending channel. Gravitational separation is effected in the channel and the liquids are then delivered to an oil-bath water cleaner from which the oil is recovered.

[from Selected Water Resources Abstracts 10(16): #W77-08015. 1977.]

3,992,297
OIL SEPARATOR DEVICE
Elisha J. Baughcom, Rte. 1, Box 15A, Newington, Ga. 30446, and Daniel C. Lee, Sr., 223 Lawton Ave., Savannah, Ga. 31404
Filed Feb. 18, 1976, Ser. No. 659,109
Int. Cl.^{2} B01D *21/24*; B03D *1/00*
U.S. Cl. 210—104 20 Claims



C-0092-78
TREATMENT OF USED OIL
Brompton, P.A. 1977.
British Patent 1,471,169

Waste oil treatment, Fuel oil, Incineration, Patent

"Discarded waste oil, e.g. from automobile transmissions, gearboxes or sumps, was efficiently burned by mixing with clean light fuel oil in ∿ 1:2 ratio. The preferred fuel oil had 35 s Redwood viscosity."

[from Chemical Abstracts 87(16): #120430h. 1977.]

C-0093-78
TEST OF A BIODEGRADABLE DEMULSIFIER IN THE ELECTRODESALTING UNIT AT THE MOSCOW PETROLEUM REFINERY
Bulatnikov, V.V., D.N. Levchenko, A.T. Sereda, and V.S. Ratush. 1976.
International Chemical Engineering 16(3):447-448.

Wastewater treatment, Refineries, Surfactants, Contamination, USSR, *Demulsifier

An 80% biodegradable demulsifer (OMK) was developed to reduce the level of waste water contamination by surfactants. Use of the OMK demulsifier results in the same degree of crude oil desalting as is obtained with other demulsifiers, but gives much less contamination of the waste water and lower corrosion rates.

[from Environmental Health and Pollution Control 12(1): #2444. 1977.]

C-0094-78
THE USE AND PERFORMANCE OF INTERCEPTORS
Chappell, T.J., and T.W. Gray. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 69-91. Proceedings of Seminar, June 22-23, 1976.

Production, Refineries, Oil-water separation, Gravity separation, *Oil interceptors

Oil interceptors are generally gravity separators for removing oil globules from wastewaters in oil production and refinery operations. Shell has designed a new plate collector concept which is discussed for both onshore and offshore applications.

C-0095-78
METHOD AND APPARATUS FOR RECOVERING COMBUSTIBLE LIQUID WASTE
Creusot-Loire Ateliers des Charmilles S.A. 1977.
Belgian Patent 844,243

Wastewater treatment, Emulsions, Incineration, Fuel oil, Patent

Oily refinery effluents and other oily wastewaters and oil-water emulsions are preheated and then combusted in a burner with a jet nozzle. The combustion is assisted by burning a light fuel through an adjacent jet nozzle.

[from Chemical Abstracts 87(14): #106565z. 1977.]

C-0096-78
REDUCTION OF WATER CONSUMPTION AND IMPROVEMENT IN WASTE WATER PURIFICATION AT THE UFA PETROLEUM REFINERY [in Russian]
Dautov, F.M. 1977.
Neftepererabotka i Neftekhimiya (Moscow) No. 4:11-13.

Wastewater treatment, Sludge, Refineries, Incineration, USSR, *Waste purification

The water consumption and waste effluents of a refinery at Ufa, USSR, were reduced significantly by use of air cooled condensers, installation of a series of wastewater purification systems, and reconstruction of a petroleum-sludge incineration unit.

[from Chemical Abstracts 87(16): #122336f. 1977.]

C-0097-78
TREATMENT OF OIL REFINERY WASTEWATERS WITH GRANULAR AND POWDERED ACTIVATED CARBON
DeJohn, P.B., and A.D. Adams. 1975.
Purdue University Industrial Waste Conference, 30th, Lafayette, Indiana, 1975. p. 216-232.

Wastewater treatment, Refineries, *Granular Carbon, *Powdered Carbon

Imperial Chemical Industries U.S., Inc., have conducted pilot and full scale studies to demonstrate that refinery wastes can be successfully treated with granular carbon in columns or powdered carbon in activated sludge. Lignite carbons perform better than bituminous coal carbon when treating refinery wastes containing large molecules, but virgin bituminous coal carbons perform better than virgin lignite carbons when treating wastes containing predominantly small molecules.

[from Environment Abstracts 7(7/8): #77-04110. 1977.]

C-0098-78
MOBIL OIL REFINERY AT WILHELMSHAVEN [in German]
Ehrenhauss, K.M. 1976.
Erdoel & Kohle, Erdgas, Petrochemie vereinigt mit Brennstoffchemie 29(10):449-452.

Refineries, Environmental protection, Pollution prevention, Equipment

Planning, site selection, and construction of this year-old 8 million tons/yr Mobil refinery are discussed. Product range, processing units, tank storage, and auxiliary facilities are also covered. The refinery's environmental protection measures and anti-pollution equipment are briefly described.

[from ERDA Energy Research Abstracts 2(18): #42579. 1977.]

C-0099-78
REMOVAL OF OIL AND GREASE FROM INDUSTRIAL WASTEWATERS
Ford, D.L., and R.L. Elton. 1977.
Chemical Engineering 17(84):49-56.

Wastewater treatment, Oil-water separation, Waste oil treatment, Industries, *Treatment processes

The current treatment technology used for oil and grease removal, and examples of treatment efficiency and typical effluent quality are presented. Processes discussed include gravity separation, air flotation, chemical coagulation, flocculation and sedimentation, biological treatment, filtration and coalescence. Membrane processes are also mentioned but are not yet demonstrated as practical.

C-0100-78
OXYGEN TRANSFER IN MECHANICALLY AGITATED AQUEOUS SYSTEMS CONTAINING DISPERSED HYDROCARBON
Hassan, I.T.M., and C.W. Robison. 1977.
Biotechnology and Bioengineering 19(5):661-682.

Hydrocarbons, *Oxygen transfer, Dispersions, *Industrial fermentations

"The effect of dispersed n-dodecane or n-hexadecane on the air-to-aqueous phase overall volumetric O_2 transfer coefficient in a simulated (cell-free) stirred-tank fermentor is described.... Depending on the combination of hydrocarbon type and volume fraction and the aqueous-phase ionic strength employed, the dispersed hydrocarbon may, in some cases, reduce the rate of O_2 transfer and in others enhance it relative to that of the corresponding oil-free gas-liquid dispersion. Enhancement of the air-to-aqueous transfer rate by such negative spreading coefficient hydrocarbons was not reported previously. [This study may be important in many industrial fermentations and aerobic biological waste treatment processes.]"

[from Biological Abstracts 64(4): #20405. 1977.]

C-0101-78
ONSHORE EXPERIENCE — PHILLIPS PETROLEUM COMPANY TEESSIDE OPERATIONS
Henricksen, H.B. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 104-112. Proceedings of Seminar June 22-23, 1976.

Oil terminal, Wastewater treatment, Ballast, Equipment, North Sea

The effluent plant at the Teesside oil terminal is described in detail. Ballast water from tankers constitutes about 80% of the wastewater treated.

C-0102-78

PRACTICAL APPLICATION OF MEMBRANE TECHNIQUES OF WASTE OIL TREATMENT
Hockenberry, H.R., and J.E. Lieser. 1977.
Lubrication Engineering 33(5):247-251.

Wastewater treatment, Refineries, Ultrafiltration, *Membrane techniques

Pilot studies investigated treatment of oily waste water with ultrafiltration and reverse osmosis. Modified acetate and similar compounds were used as ultrafiltration membranes; reverse osmosis membranes were made of organic materials treated to become semipermeable. Both systems had tubular membrane construction. The basic theory of both processes was presented.

[from Selected Water Resources Abstracts 10(19): #W77-09418. 1977.]

C-0103-78

HEAVY METALS IN EFFLUENTS FROM OIL REFINERIES
Huber, L. 1977.
Erdoel, Kohle, Erdgas, Petrochemie 30(6):276.

Wastewater, Refineries, Chemical analysis, *Heavy metals

Heavy metals in refinery effluents are derived primarily from the crude oil, from refinery and waste treatment processes, and from corrosion materials and corrosion inhibitors. Removal methods include chemical precipitation and biological sorption during activated sludge treatment.

[from Chemical Abstracts 87(14): #106449q. 1977.]

C-0104-78

APPARATUS FOR THE CONTINUOUS MEASUREMENT OF THE OIL CONCENTRATION IN OIL-CONTAINING LIQUIDS
Iwamoto, M., and T. Nomura. 1977.
German Offenlegungsschriften (unexamined patent application) 2,701,075

Analytical techniques, Monitoring, Wastewater treatment, Residual oils, Recycling, Patent, *Infrared analyzer

Oily wastewaters are treated with Freon or CCl_4, filtered, and the oil is passed to an infrared analyzer. Residual oil-solvent-water mixtures are further treated and filtered and the oil is recovered for recycling.

[from Chemical Abstracts 87(14): #106563x. 1977.]

C-0105-78

PUMP-FILTER FOR BILGE WATER

Jakubek, P., and K. Biswanger. 1976.

U.S. Patent 3,996,136

Bilges, Oil-water separation, Filtration, Patent, Equipment

Bilge water is fed into a separation chamber in the bottom of a two-part housing where it undergoes preseparation so that the liquid pollutant rises to the top. The liquid is pumped vertically down in the compensation chamber through a filter and is then withdrawn in a highly pure state.

[from Selected Water Resources Abstracts 10(16): #W77-08261. 1977.]

3,996,136

PUMP-FILTER FOR BILGE WATER

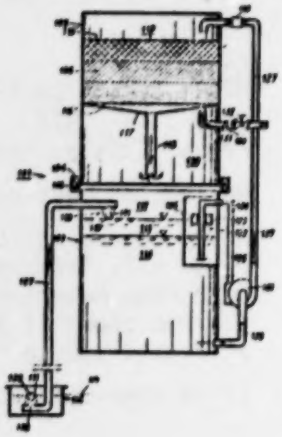
Peter Jakubek, 48, Heinrich Collinstrasse, A-1140 Vienna, and Karl Biswanger, Schottenfeldgasse 77, A-1070 Vienna, both of Austria

Continuation-in-part of Ser. No. 342,252, March 16, 1972, Pat. No. 3,852,193. This application Dec. 4, 1974, Ser. No. 528,938

Claims priority, application France, Nov. 15, 1974, 74.37724

Int. Cl.^{2} B01D *35/00*

U.S. Cl. 210—86 **7 Claims**



C-0106-78

REMOVAL OF PETROLEUM PRODUCTS FROM WASTE WATERS BY FLOTATION [in Russian]

Kuznetsov, V.N., V.V. Borovkov, and A.N. Balaskov. 1977.

Khimicheskaya Promyshlennost (Moscow) No. 7:508-509.

Wastewater treatment, Petroleum products, Flotation

A three-stage flotation process is described which consists of air flotation, followed by electroflotation with H and O, respectively.

[from Chemical Abstracts 87(14): #106472s. 1977.]

C-0107-78
WASTE WATER BASE DRILLING FLUID DISPOSAL
Louden, L.R., and R.E. McGlothlin. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 515-522. Proceedings.

Wastewater treatment, Drilling, Disposal, *Mud solidification process

A mud solidification process is described which converts oil well drilling waste fluids into a nontoxic material that is environmentally acceptable for disposal. The process is based on controllable reactions between soluble silicates and silicate setting agents, which can be used to solidify drilling muds and cuttings.

C-0108-78
AIR FLOTATION OF OILY WASTE WATERS WITH ORGANIC COAGULANTS
Luthy, R.G. 1976.
PhD Thesis, University Microfilms, Inc., Order No. 77-4519. 181 p.

Wastewater treatment, Refineries, Flocculation, Flotation, *Coagulation

An attempt was made to identify the conditions for removing emulsified oil from refinery wastewaters by using organic coagulants. The emulsion properties affecting oil droplet flocculation and flotation were also studied.

[from Selected Water Resources Abstracts 10(16): #W77-08282. 1977.]

C-0109-78
STRATEGY OF POLLUTION CONTROL
MacBerthouex, P., and D.F. Rudd. 1977.
New York, Wiley, 1977. 579 p.

Wastewater treatment, Solid wastes, Industries, Pollution control, Cost analysis.

This book explains present technology and treatment processes available for handling industrial wastes. Although all aspects of environmental engineering are covered — air, water, solid waste — the emphasis is on water pollution control. Background information on the environment and specific pollutants is presented, followed by a discussion of individual processes and integrated physical and chemical treatment systems. The last chapter addresses institutional problems and cost-benefit analyses which influence environmental decision-making.

[from Chemical Engineering 84(11):13-14. 1977.]

C-0110-78
CARBON TREATMENT OF OTTO FUEL WASTEWATER — A LABORATORY STUDY
Mastroianni, J.E., and W.F. Newton. 1977.
Final Report No. NSWC/WOL/MP-77-7. (1 Jul 72-30 Jun 73). 24 p.

Wastewater treatment, Fuel oil, Adsorption, Incineration, *Activated carbon, *Otto fuel

Otto fuel can be effectively removed from water by activated carbon. Preliminary tests using Filtrasorb 400 show a carbon cost of 0.5¢/L (1.8¢/gal) of wastewater treated compared to 11¢/L (43¢/gal) for disposal by incineration. A future report will investigate a prototype wastewater system which uses a carbon adsorption stage.

[from Government Reports Announcements 77(18): #AD-A040 986/2GA. 1977.]

C-0111-78
RESOLVING OIL-IN-WATER EMULSIONS BY THE USE OF A CATIONIC POLYMER AND THE WATER SOLUBLE SALT OF AN AMPHOTERIC METAL
Mauceri, F.A. 1977.
U.S. Patent 4,026,794

Emulsions, Flocculation, Oil-water separation, Patent

"Wastewater containing 1.0-100,000 ppm oil is treated by adding to the wastewater ($pH < 10$) 2.0-20,000 ppm of an aqueous composition containing 15-50% of a water-soluble salt of an amphoteric metal and 1.0-15% of a 10-60:5-40:5-70 acrylamide-diallyldimethyl=ammonium chloride-N-vinyl-2-pyrrolidinone copolymer (mol. wt. 5000-300,000), thereby forming a floc containing the oil."

[from Chemical Abstracts 87(16): #122474z. 1977.]

C-0112-78
RECOVERY OF OIL FROM REFINERY SLUDGES BY STEAM DISTILLATION
McCoy, D.E. 1977.
U.S. Patent 4,014,780

Sludge, Oil-water separation, Reclamation, Refineries, Patent

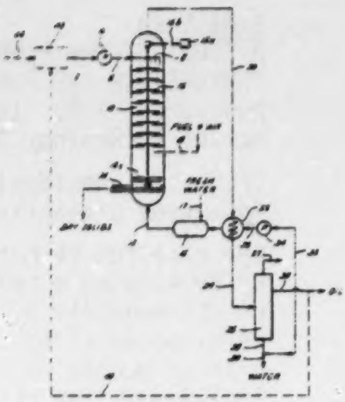
Petroleum refinery sludges are deoiled and dewatered by a process that involves contacting the sludge with super-heated steam to effect separation into dry oil free solids and an oil-water vapor phase. Upon cooling, the vapor phase condenses into an oil-water mixture which is separated and yields oil useful as a cracking stock.

[from Chemical Abstracts 87(14): #104378s. 1977.]

4,014,780

RECOVERY OF OIL FROM REFINERY SLUDGES BY STEAM DISTILLATION

Drew E. McCoy, Nederland, Tex., assignor to Texaco Inc., New York, N.Y.
Filed Apr. 14, 1975, Ser. No. 567,585
Int. Cl.² C10G *31/08*
U.S. Cl. 208—13 5 Claims



C-0113-78

DISPOSAL OF DRILLING FLUIDS AND DRILLED-UP SOLIDS IN OFFSHORE DRILLING OPERATIONS

McGuire, W.J. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 523-530. Proceedings.

Wastewaters, Offshore drilling, Disposal, Pollution prevention, *Oily drill cuttings

Whenever possible, water-based drilling muds are used in offshore applications. When use of oil-base muds is necessary, the cuttings must either be transported to shore for storage, reclamation of the oil, and disposal of solids, or the cuttings are treated by incineration or washing with surfactants before offshore disposal.

C-0114-78

HANDLING AND TREATMENT OF OIL-BASE DRILLING MUDS

McMordie, W.C., Jr. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 505-513. Proceedings.

Drilling, Solid wastes, Disposal, *Oil base drilling muds, *Drill cuttings

Oil-based drilling muds contain diesel oil, inorganic solids, surfactants, asphalt, and water. Their disposal is problematic because an oily coating remains on the drill cuttings. Treatment of such cuttings to assure environmentally safe disposal includes 1.) containerizing all cuttings and returning to mud plant for authorized disposal; 2.) washing the cuttings with surfactants; and 3.) incinerating the cuttings to remove all hydrocarbons.

C-0115-78
A STUDY OF THE FORMATION OF UNPUMPABLE RESIDUES OF CRUDE OIL ON TANKERS FOR THE PURPOSE OF PREVENTING MARINE POLLUTION
Nunuparov, S.M. 1977.
Marine Technology Society Journal 11(3):9-17.

Crude oil, Residual oils, Waste oil disposal, Tankers, Oil tanks, Pollution prevention

The research reported here aims at preventing marine pollution by developing a universal criterion for an objective estimation of the quantity of declared residues in slop tanks which are to be disposed of by tankers. The adhesiveness of various crude oils to models of inner tank surfaces was studied, and variables included design characteristics of various tankers, the spatial orientation of wet surfaces, and the typical corroded condition of tanks. After mathematical analysis, methods are recommended for estimating the anticipated volumes of crude oil residues in tankers relative to operating conditions, and for optimizing tank washing procedures with reduced ship energy expenditure.

C-0116-78
SLUDGE REMOVAL
Ogura, Y., and Y. Mizuno. 1977.
Japanese Kokai (unexamined patent application) 77 72,369

Oil tanks, Sludge, Crude oil, Patent, *Sludge removal

Crude oil containing polyethylene glycol nonylphenyl ether-formaldehyde condensate and dioctyl sulfosuccinate was used to dissolve sludge accumulated on the crude oil tank bottom.

[from Chemical Abstracts 87(18): #140850y. 1977.]

C-0117-78
REMOVAL OF TARS AND OILS FROM WASTE WATERS IN RADIAL SETTLING TANKS [in Russian]
Pimenov, J.V., E.K. Derbysheva, L.A. Kopytova, and V.M. Kagasov. 1977.
Koks i Khimiya No. 4:49-57.

Wastewater treatment, Tar, Waste oil, Biological treatment, *Radial clarifiers

"The operation of radial clarifiers used in the first stage of biochemical purification of wastewaters depends on the concentration and dispersion of the tar and oil particles."

[from Chemical Abstracts 87(14): #106422a. 1977.]

C-0118-78
REMOVAL OF OILS AND RESINS FROM WASTE WATERS
Privalov, V.E., E.I. Vail, G.I. Papkov, V.Z. Orlova, et al. 1977.
USSR Patent 452,185

Wastewater treatment, Adsorption, Patent

Oils and resins in wastewater were effectively adsorbed by coal dust treated with organosilicones.

[from Chemical Abstracts 87(14): #106559a. 1977.]

C-0119-78
DISCHARGE OF OILY WASTE WATER FROM THE PRODUCTION OF HYDROCARBONS ON THE NORWEGIAN CONTINENTAL SHELF
Schreiner, O. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 113-122. Proceedings of Seminar, June 22-23, 1976.

OCS, Oil discharges, Wastewater treatment, Offshore production, Environmental protection, Regulations, North Sea

Soon, 8 or 9 offshore oil fields will be in full production in the North Sea, and the discharge of oily wastes into the North Sea will increase. Realistic systems are being designed for use so that the marine environment will receive minimal damage from oily wastewater. Environmental regulations are outlined and discussed.

C-0120-78
OIL REMOVING APPARATUS
Seo, M. 1977.
Japanese Kokai (unexamined patent application) 77 59,072

Wastewater treatment, Adsorption, Design-engineering, Patent, Equipment

The apparatus consists basically of a vessel containing at the base a layer of activated carbon, which is overlain by several laminated filters made from oil adsorbent material. Oily wastewater is introduced at the top of the vessel.

[from Chemical Abstracts 87(14): #106570n. 1977.]

C-0121-78
THE TOXICITY OF DRILLING FLUIDS, THEIR TESTING AND DISPOSAL
Shaw, D.R. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 463-471. Proceedings.

Drilling, Toxicity, Disposal, Oil industry, Guidelines, Wastewaters, *Drilling fluids

The more than 600 components and combinations of chemicals that comprise oil well drilling fluids can be quite toxic to plant and animal life, and their possible synergestic effects are largely unknown. For these reasons, guidelines and standards for the environmentally safe disposal of drilling fluids are outlined, and suggestions to ensure cooperation between private industry and government agencies are presented.

C-0122-78
COMMUNITY METABOLISM IN A REFINERY HOLDING POND
Seigal, B.A., and R.C. Harrel. 1976.
Journal Water Pollution Control Federation 48(10):2249-2258.

Wastewater treatment, Refineries, Metabolism, Toxicity, *Holding pond

Physico-chemical and diurnal oxygen curve methods were used to analyze the properties of community metabolism of a Texas oil refinery holding pond. It was found that waste toxicity could be lowered by aerating untreated wastes before lagooning. Sulfides and excessive algae could be removed by deepening, baffling, and construction of a polishing pond.

[from Environmental Health and Pollution Control 12(1): #2452. 1977.]

C-0123-78
REGULATIONS OF ONSHORE AND OFFSHORE OIL FIELD WASTE DISPOSAL
Smith, J.E. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 579-584. Proceedings.

Drilling, Waste oil disposal, Oil spills, Regulations, State governments, Texas

The Texas Railroad Commission, a state agency, is responsible for waste disposal including wastes from oil and gas operations on state lands and state waters. The exercise of these responsibilities is authorized by general statutes, statewide rules, and special orders.

C-0124-78
TREATMENT AND DISPOSAL OF WASTE FLUIDS FROM ONSHORE DRILLING SITES
Specken, G.A. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 451-462. Proceedings.

Drilling, Wastewater treatment, Sludge, Disposal, Cost analysis

Onshore oil/gas drilling necessitates the safe storage and disposal of up to 100,000 barrels of waste fluids of various compositions. A process is described whereby the liquid drilling wastes are treated at the drill site to yield environmentally acceptable wastewaters and sludges that can be safely buried or disposed of. Cost analyses indicate that the process is cost-effective.

C-0125-78
TREATMENT OF EMULSION-TYPE WASTEWATER WITH SULFURIC ACID PITCH
Takaoka, S. 1976.
Japanese Kokai (unexamined patent application) 76,145,163

Wastewater treatment, Emulsions, Patent, *Sulfuric acid pitch

"Acid pitch from waste oil treatment with H_2SO_4 is used for wastewater treatment in oil-in-water or water-in-oil-type emulsion form.

[from Chemical Abstracts 87(16): #122461t. 1977.]

C-0126-78
TREATMENT OF [illegible]WATER WITH ACTIVATED CARBON [English summary]
Tatsumoto, H[illegible]M. Kitagawa. 1976.
Sekiyu Gakka[illegible]9(3):230-233.

Wastewater treatment, Refineries, Detection, Absorption, *Activated carbon

The successful use of activated carbon in detecting and absorbing trace quantities of oil in refinery wastewaters is described. Optimal absorption occurs at pH 6-8.

[from Chemical Abstracts 87(16): #122421e. 1977.]

C-0127-78
ADSORBENT FOR EMULSIFIED OIL
Toda, K., Y. Takahashi, S. Amagi, and Y. Iwata. 1977.
Japanese Kokai (unexamined patent application) 77 68,091

Wastewater treatment, Emulsions, Adsorption, Patent

"At least 1 of MgO, $Mg(OH)_2$, and $MgCO_3$ (av. diam. $\leq 100\mu$), optimally activated C, are loaded on a natural or synthetic polymer. Thus, acrylic fiber (3 denier 70 mm long) was soaked in ethylene-vinyl acetate emulsion adhesive, centrifuged, dusted with MgO (1μ), dried 5 h at 80°, and packed in a column. A car-washing machine effluent containing 37 ppm oil and 8.4 ppm nonion surfactact, was treated and water contained 8.5 ppm oil."

[from Chemical Abstracts 87(18): #140810k. 1977.]

C-0128-78
REMOVAL OF EMULSIFIED OIL
Toda, K., S. Amagi, and Y. Iwata. 1977.
Japanese Kokai (unexamined patent application) 77 68,090

Wastewater treatment, Emulsions, Surfactants, Patent

"An emulsified oil is stirred with a solution containing ≥ 1 of MgO, $Mg(OH)_2$, and $MgCO_3$ of average diameter $\leq 100 \mu$. Thus wastewater from a car-washing machine containing oil 35, nonionic surfactants 8, and anionic surfactants 3 ppm was mixed with 0.1 g ∿ 50μ size MgO/L wastewater and settled 2 h to contain 7 ppm oil vs. 20.5 ppm with activated C."

[from Chemical Abstracts 87(18): #140811m. 1977.]

C-0129-78
THE USE AND PERFORMANCE OF GAS FLOTATION SYSTEMS
Turner, D.L. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 92-103. Proceedings of Seminar, June 22-23, 1976.

Wastewater treatment, Flotation, Oil-water separation, Ballast, Refineries

Gas flotation is a common technique used to treat oily wastewater effluent. The process unites gas bubbles with solids to achieve a reduction in the combined specific gravity, which accelerates oil-water separation. The two processes in use, Dissolved Gas and Dispersed Gas flotation, are discussed.

C-0130-78
WASTE OIL-TREATING AGENTS
Ueda, S. 1977.
Japanese Kokai (unexamined patent application) 77 49,203

Lubricating oils, Waste oil treatment, Patent

A purification method for waste lubricating oils was developed by using hydroxycarboxylic acid ethanolamine esters having pH 5.5-8, obtained by condensing C_{2-10} hydroxycarboxylic acids with ethanolamines. Experimental waste automobile lubricating oil containing residual C 1.26, water 0.05, ash 0.48, and S 1.19% had those levels reduced to residual C 0.39, water 0, ash 0.10, and S 0.74%.

[from Chemical Abstracts 87(18): #138488t. 1977.]

C-0131-78
THE DEVELOPMENT OF A TREATMENT PROCESS FOR THE LIQUID WASTES OF A LARGE REFINERY AND PETROCHEMICALS COMPLEX
Vandyke, K.G. 1977.
Proceedings of the Effluent and Water Treatment Convention, 1976. Vinall, H. (ed.). Birmingham, England, Brintex Exhibitions Ltd., 1977. 10 p. (Paper No. 5).

Wastewater treatment, Refineries, Petrochemicals, Flocculation, Flotation, Activated sludge

A communal water treatment process is used by plants in a large refinery and petrochemicals complex. A summary is presented of the pretreatment, flocculation, flotation, and activated-sludge processes. Final standards of effluents include 5 mg/L oil.

[from Chemical Abstracts 87(18): #140662p. 1977.]

6. OIL-WATER SEPARATION

C-0132-78
OIL-WATER SEPARATOR HELPS AVOID ENVIRONMENTAL POLLUTION FROM OIL SPILLS (product information)
Anon. 1977.
Journal of Canadian Petroleum Technology 16(3):129.

Oil-water separation, Oil spills, Hydrocarbons, Gravity separation, Equipment

An oil-water separator, using a gravity displacement separator, is described. The product has baffles and separation chamber but no moving parts. For more information contact Enquip, Inc., PO Box 50349, Tulsa, OK 74150.

C-0133-78
SEPARATOR PREVENTS POLLUTION (product information)
Anon. 1977.
Oil & Gas Journal 75(48):161.

Oil-water separation, Wastewater treatment, Design-engineering, Gravity separation, Equipment

Enquip, Inc., is marketing a gravity displacement-type oil-water separator. Its separation chamber and baffle arrangement allow it to operate under a wide range of oil-water mixtures and flow rates. The equipment has no components that are mechanically operated or need to be adjusted. The separator is available from Enquip, Inc., Box 50349, Tulsa, OK 74150.

C-0134-78
THE REMOVAL OF EMULSIFIED OIL PARTICLES FROM WATER BY FLOTATION
Angelidou, C., E. Keshavarz, M.J. Richardson, and G.J. Jameson. 1977.
Industrial and Engineering Chemistry, Process Design and Development 16(4):436-441.

Oil-water separation, Emulsions, Flotation, Surfactants, Seawater

The flotation of the emulsified oil particles of two oils (a cutting oil or machining lubricant, and white spirit, a petroleum-based turpentine substitute) suspended in low concentrations of water was studied. Various cationic surfactants were used for the separation in the flotation cell which was operated batchwise with an external total recycle. The rate of flotation in water increased with the addition of surfactant and decreased in the presence of sea salt.

[from Chemical Abstracts 87(18): #140709j. 1977.]

C-0135-78
THE SEPARATION OF OIL FROM WATER FOR NORTH SEA OPERATIONS
Department of the Environment. 1976.
London, Her Majesty's Stationery Office, 1976. 29 p. (Pollution Paper No. 6).

Oil-water separation, Environmental effects, Crude oil, Oil discharges, Wastewater treatment, UK, North Sea

Increased oil pollution problems are expected from expanding offshore production in the North Sea. This report describes oily water discharges which are likely to occur and discusses their environmental impact. Current methods of separating oil from wastewaters are given and guidelines are proposed for achieving acceptable levels of oily water discharges.

C-0136-78
REMOVAL OF PETROLEUM PRODUCTS FROM AQUEOUS EMULSIONS BY AERATION WITH COMPRESSED AIR [English summary]
Grunwald, A. 1976.
Sbornik Vysoke Skoly Chemicko-Technologicke v Praze, Technologie Vody F20:23-52.

Oil-water separation, Emulsions, Petroleum products, Fuels, Lubricating oil, Hydrocarbons, *Aeration

Aeration with compressed air was tested for removing petroleum products from aqueous emulsions and found to be effective in removing those composed partially or entirely of volatile hydrocarbons. In a sample aeration test of products including automotive and jet gasoline, kerosine, diesel fuel, fuel oil, and transmission oil, the automobile gasoline was removed with 100% efficiency compared to 0.006% for the transmission oil. The transmission oil contained the lowest amount of volatile hydrocarbons of the products tested.

[from Chemical Abstracts 87(16): #120090x. 1977.]

C-0137-78
METHOD OF FILTERING OIL FROM LIQUIDS
Hirs, G. 1976.
U.S. Patent 3,992,291

Oil-water separation, Wastewater treatment, Filtration, Patent

The contaminated liquid is passed through a bed of granulated black walnut shells which have a relatively weak affinity for oil. The suspended oil is coalesced during flow through the filter bed to form globular oil particles that can be entrapped in the interstices of the filter bed. The bed is rejuvenated by flowing backwash liquid through to provide a high velocity scrubbing to free the accumulated oil from the bed. The bed is reformed and the filtration cycle is repeated.

[from Selected Water Resources Abstracts 10(16): #W77-08011. 1977.]

C-0138-78
THE SEPARATION OF OIL FROM WATER FOR NORTH SEA OPERATIONS
Institute of Offshore Engineering. 1977.
Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. 124 p. Proceedings of Seminar, June 22-23, 1976.

Oil-water separation, Refineries, Offshore production, Wastewater treatment, Design-engineering, Disposal, Environmental effects, Monitoring

Presented are 9 technical papers that were given at the title seminar, and a summary of the formal discussions during the meetings. Topics covered include the performance of currently available oil/water separation systems, the practicability of monitoring oily water discharge from such systems, and the current understanding of the likely environmental effects of such discharges.

C-0139-78
REFINERY OIL/WATER SEPARATION EQUIPMENT AND ITS APPLICATIONS
Kirkup, W.M. 1977.
Filtration and Separation 14(3):259-262, 264, 266.

Oil-water separation, Refineries, Wastewater treatment, Filtration, Gravity separation, Flotation, Equipment

Equipment used in wastewater treatment at petroleum refineries includes plate separators, sand filters, rotary vacuum filters, hay filters, gravity separators, and dissolved air flotation units.

[from Chemical Abstracts 87(18): #140649q. 1977.]

C-0140-78
REMOVAL OF OIL FROM AQUEOUS EMULSIONS
Negi, Y., Y. Shimizu, and Y. Yamauchi. 1977.
Japanese Kokai (unexamined patent application) 77 73,175

Oil-water separation, Emulsions, Adsorption, Patent, *Synthetic fibers

"Oil emulsified in water was removed by stirring with synthetic pulp (fiber length <20mm) from 60:40 poly=propylene-polyethylene blend in the presence of polyaluminum chloride, $Al_2(SO_4)_2$, $Fe(SO_4)_3$, polyethylenimine, dialkyl-dimethylammonium chloride-SO_2 copolymer, or poly(vinyl=pyridine)-HCl."

[from Chemical Abstracts 87(16): #122496h. 1977.]

C-0141-78
TREATMENT OF OIL-CONTAINING WASTEWATER
Nishikaji, T., O. Kamada, and K. Fukazawa. 1976.
Japanese Kokai (unexamined patent application) 76,149,171

Oil-water separation, Wastewater treatment, Flotation, Dispersions, Emulsions, Patent

A method for treating oil dispersions or emulsions is described. First flotation is used in the oil-water separation where a water-soluble polyvalent metal salt is added to an oily wastewater.

Then after removal of the floating matter, the salt is precipitated by addition of a precipitating agent to the water.

[from Chemical Abstracts 87(18): #140785f. 1977.]

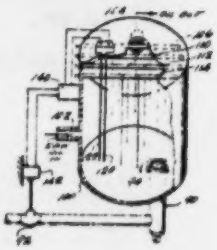
C-0142-78
ALTERNATING CURRENT ELECTROSTATIC OIL WATER SEPARATION
Oros, R.G. 1977.
U.S. Patent 4,033,851

Oil-water separation, Patent, *Electrostatic separation, Equipment

The title apparatus consists of a treatment tank with an inlet for the untreated mixture, and separate oil and water outlets situated above and below the inlet, respectively. Pairs of electrodes of different length and voltage potentials are suspended in the tank, which sense the different conductivities of oil and water. When the conductivity reaches a certain predetermined value, the water outlet is opened.

[from Chemical Abstracts 87(16): #122489h. 1977.]

4,033,851
A.C. HYDROELECTROSTATIC PRECIPITATOR
Richard G. Oros, Grand Rapids, Mich., assignor to C&O Railroad Company, Cleveland, Ohio and B&O Railroad Company, Baltimore, Md.
Continuation of Ser. No. 450,215, March 11, 1974, abandoned. This application June 25, 1976, Ser. No. 699,969
Int. Cl.^{2} C10G *33/02*
U.S. Cl. 204—302 **7 Claims**



C-0143-78
METHOD FOR THE NON-MECHANICAL CONVEYING OF A COLLECTED QUANTITY OF LIQUID AND APPARATUS FOR THE PERFORMANCE OF THE METHOD
Perren, B. 1977.
U.S. Patent 4,022,687

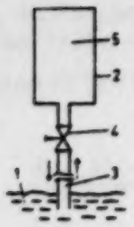
Oil-water separation, Spill cleanup, Gravity separation, Patent

A method for removing an oil spill from water is described. The main feature is a liquid with a specific gravity greater than that of oil. It flows under the oil, but on top of the water, making cleanup easier than conventional methods.

4,022,687

METHOD FOR THE NON-MECHANICAL CONVEYING OF A COLLECTED QUANTITY OF LIQUID AND APPARATUS FOR THE PERFORMANCE OF THE METHOD

Benno Perren, Austrasse 33, 5430 Wettingen, Switzerland
Filed Mar. 21, 1975, Ser. No. 560,683
Claims priority, application Switzerland, Mar. 28, 1974, 4383/74
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210—65 **5 Claims**



C-0144-78
APPARATUS AND METHOD FOR SEPARATING EMULSIONS
Wikholm, K.O. 1976.
German Offenlegungsschriften (unexamined patent application) 2,556,347

Oil-water separation, Emulsions, Patent, Equipment

An oil-water emulsion can be separated by introducing it under slow laminar flow conditions at the interface of an oil and water layer. Optimal demulsification occurs if the temperature of the emulsion is slightly higher than that of the water and oil layer.

[from Chemical Abstracts 87(10): #72944e. 1977.]

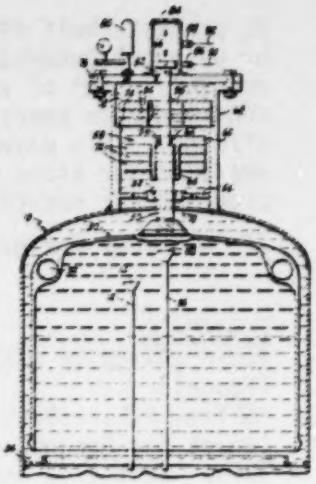
C-0145-78
GRAVITATIONAL SEPARATOR FOR MIXTURES OF IMMISCIBLE LIQUIDS OF DIFFERENT DENSITIES
Wright, D.A., and C.H. Walters
U.S. Patent 4,032,444

Oil-water separation, Coalescence, Gravity separation, Design-engineering, Patent, Equipment

Oil and water are separated by means of a dome-like diaphragm which floats in the oil water mixture, and a balance means, which senses and signals the accumulation of a predetermined amount of oil. When the signal is activated, means are provided to coalesce and remove the oil from the area of accumulation.

[from Chemical Abstracts 87(10): #70234z. 1977.]

4,032,444
GRAVITATIONAL SEPARATOR FOR MIXTURES OF IMMISCIBLE LIQUIDS OF DIFFERENT DENSITIES
David A. Wright, and Chester H. Walters, both of St. Louis, Mo., assignors to National Marine Service, Inc., St. Louis, Mo.
Filed Aug. 29, 1975, Ser. No. 608,905
Int. Cl.^{2} B01D *17/02*
U.S. Cl. 210—86 **11 Claims**



C-0146-78
SEPARATION OF FREE OIL FOLLOWING COALESCENCE
Wu, C.-C.J., R.S. Schechter, J.F. Malina, Jr., and E.F. Gloyna. 1977.
Texas University at Austin, Center for Research in Water Resources, Technical Report CRWR-143. 116p.

Oil-water separation, Coalescence

Six separators were evaluated with emphasis on oil removel efficiency and headloss. Experimental results indicated that the Model I separator effectively removed oil from water under low flow rate conditions, and the Model VI separator was more successful under high flow rates. Ninety-eight percent oil removal was achieved.

[from Pollution Abstracts 8(5): #77-04443. 1977.]

7. RECLAMATION AND REUSE

C-0147-78
A MODEL USED OIL RECYCLING ACT
Irwin, W.A. 1976.
Washington, D.C., Environmental Law Institute, 1976. 12 p.

Recycling, Waste oil, Models, Legislation, Environmental protection

At present, half of the more than 3.79 billion L (1 billion gal) of used oil generated annually in the U.S. is lost from a resource recovery point of view. Increased collection and recycling would contribute to energy conservation and environmental protection efforts. This pamphlet contains a model bill, with commentary, designed for state and local governments interested in adopting programs for recycling used oil.

[from Energy Review 21:12. 1977.]

C-0148-78
REGENERATION OF USED LUBRICATING OILS: REPORT AND IMPORTANCE [in French]
Rollin, A.L. 1976.
Impact des Projets sur l'Environnement, Congres AQTE, 14th, Montreal, 1976. Montreal, Association Quebecoise des Techniques de L'eau, 1976. 18 p. (Paper No. 21.).

Lubricating oil, Waste oil, Reclamation

"A review with 7 references."

[from Chemical Abstracts 87(14): #104010r. 1977.]

8. PERSONNEL TRAINING AND EDUCATION

C-0149-78
HOW TO CONTROL BLOWOUTS IN UNDERBALANCED DRILLING
Grace, B. 1977.
Petroleum Engineer 49(10):64, 66, 72, 74.

Personnel training, Blowout prevention, *Early warning techniques

The author warns that investigations and evaluations of early warning techniques such as flowline temperature, drilling rate, and shale density are critical in blowout control. Solutions for controlling problems that occur with underbalance and productivity combinations are outlined. A case history is evaluated with mathematical and chemical calculations.

9. PREVENTION AND CONTROL MEASURES

C-0150-78
CHANCES FOR MISHAPS IN TROUBLED WATERS PROMPTS PROTECTIVE DEVELOPMENTS
Anon. 1977.
Offshore 37(11):62-64.

Equipment, Ekofisk blowout, Spill cleanup, Design-engineering, Contingency planning, Norway, North Sea

The blowout on Ekofisk Bravo (April 1977) in the North Sea, combined with the potential for mishaps in its rough waters, has led Norwegian designers to produce several anti-pollution devices. A powder called "Oil Killer" is used to bind oil into floes, which can be retrieved by net or pump. A 12,000 ton dwt tanker has been fitted with oil skimmers and displacement-type recovery tanks. Another innovation is a monitor stabilizing system which kept the Seaway Falcon on target as she pumped water on the Ekofisk Bravo.

C-0151-78
MORE PRECAUTIONS AGAINST OIL SPILLS NEEDED (news brief)
Anon. 1977.
Marine Pollution Bulletin 8(8):173-174.

Fish, Birds, Habitat, Spill Cleanup

The International Union for Conservation of Nature (IUCN) is urging immediate research to prepare maps showing areas where fish spawn and seabirds breed in order that future spill cleanups may be carried out with minimum risk to both. Studies may be part of the World Wildlife Fund's "The Seas Must Live" campaign for marine conservation. While information concerning plaice, cod, and haddock is fairly well-documented, mackerel, herring, and sprat deserve more attention.

C-0152-78
EPA'S R & D EFFORTS ON THE CONTROL AND EFFECTS OF OIL POLLUTION
Gage, S.J. 1977.
Spill Technology Newsletter 2(4):56-61.

Spill containment, Spill cleanup, Environmental effects, Chronic effects, EPA, *Research programs

The EPA's research and development priorities in the area of oil pollution effects and control are summarized. In the area of spill control, successful spill containment and recovery at currents greater than 3.7 km/hr (2 knots), and spill cleanup in icy waters, in marshes and along beaches is receiving great attention. The long-term ecological damage of oil spills, and the sublethal effects of chronic oil pollution are other areas of current research emphasis.

C-0153-78

U.S. NOAA RESEARCH ACTIVITIES ON THE FATE AND EFFECTS OF OIL SPILLS
Hess, W.N. 1977.
Spill Technology Newsletter 2(4):51-55.

Pollution control, Monitoring, Spill cleanup, Behavior, Fate, Biological effects, NOAA, *Research programs

NOAA's responsibilities and capabilities in monitoring and combatting oil spills and oil pollution are reviewed, and areas for suggested further reserach are outlined. Long-term research commitments are needed to better understand the physical processes affecting oil spilled into the marine environment, its chemical changes with time, and its long-term biological effects.

C-0154-78

THE DESIGN OF ONSHORE OIL/WATER TREATMENT SYSTEMS — ENVIRONMENTAL AND TECHNICAL CRITERIA
Johnston, C.S. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 46-68. Proceedings of Seminar, June 22-23, 1976.

Pollution control, Guidelines, Oil discharges, Ballast, Oil terminal, Biological effects, Marine organisms, Regulations

If the planning stages of production development include practical environmental protection guidelines, future pollution problems can be lessened, usually at cost-effective rates. Applications of environmental criteria are presented for oil terminals, ballast treatment and discharge systems, and the acute and chronic effects of oil pollution on marine organisms are outlined.

C-0155-78

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON MARINE POLLUTION RESEARCH HELD IN GULF BREEZE, FLORIDA, ON JANUARY 27-29, 1976
Meyers, S.P. 1976.
Final report, EPA/600/9-76/032, ERL.GB-324; Grant EPA-R-803141-01-0. 177 p.

Pollution prevention, Coasts, *Symposium

Symposium papers discuss how man's activities have affected natural resources of the coastal environment. Various international aspects of coastal pollution are covered, and the current status of research and procedures planned to minimize offshore coastal damage are reviewed.

[from Government Reports Announcements 77(17): #PB-267 601/3GA. 1977.]

C-0156-78
BEING PREPARED FOR FUTURE ARGO MERCHANTS
Milgram, J. 1977.
Technology Review Vol. 79:14-27.

Pollution control, Argo Merchant spill, Tankers, Spill cleanup, Behavior, Personnel training

Details of the Argo Merchant spill off Massachusetts (Dec. 1976) are recounted and problems with spill containment and dispersal are reviewed. Discussion includes emergency action to deal with stricken and grounded vessels, building of stronger hulls with double bottoms, spill cleanup, the behavior of oil, the effects of wave action on spills, and the uses of barriers and skimmers. Recommendations are made for stockpiling of spill cleanup equipment and vessels and for prepared personnel trained in emergency spill response.

[from International Aerospace Abstracts 17(21): #A77-45228. 1977.]

C-0157-78
BEING PREPARED FOR FUTURE ARGO MERCHANTS
Milgram, J. 1977.
MITSG-77-10, NOAA-77050402, Grant NOAA-04-6-158-44081. Index No. 77-410-Nfw. 51 p.

Argo Merchant spill, Pollution prevention, Equipment, Tankers, Spill cleanup, Personnel training

For summary see previous citation.

[from Government Reports Announcements 77(19): #PB-269 696/1GA. 1977.]

C-0158-78
PETROLEUM AND THE ENVIRONMENT
Pendleton, H.E. 1977.
Pollution Engineering 9(9):42-43.

Environmental management, Oil Industry, Economics, API, EPA

The manager of environment and information services for API claims for the petroleum industry an historical concern for the environment. The author calls for lowered requirements from the Clean Air Act, and cites reasons for the 1977 deadline for the Phase I requirements of the water act to be extended. He also proposes that the 1983 Phase II requirements be lessened or deleted, as "dramatic improvements [in water quality] are bound to come" without these stipulations.

C-0159-78
POLLUTION CONTROL AND OIL INDUSTRY [English summary]
Schoenfellinger, H.W. 1976.
Erdoel, Erdgas Zeitschrift 92(9):308-310.

Pollution control, Oil industry, Surveillance, *Survey

A survey is presented of pollution control bodies and regulated organizations that have been set up in the last 2 decades. Specific mention is made of the 1972 Stockholm Conference on Man and Environment UNEP, IPIECA, and Austrian control groups.

[from Environmental Health and Pollution Control 12(1): #2447. 1977.]

C-0160-78
U.S. COAST GUARD OIL SPILL COUNTERMEASURES ACTIVITIES
Schubert, F.P. 1977.
Spill Technology Newsletter 2(4):42-49.

Spill cleanup, Spill recovery, Argo Merchant spill, USCG, Source identification, Contingency planning

A brief review of the 1976 Argo Merchant spill and other recent incidents is made in order to point out the areas in which the present oil spill cleanup and containment technology is most inadequate, mainly under severe weather, current, and ice conditions. Ongoing USCG research and development programs in the areas of oil recovery techniques and devices, airborne oil surveillance, oil identification methods, spill response teams, and contingency planning are briefly mentioned.

C-0161-78
MANAGEMENT OF MID-ATLANTIC OFFSHORE DEVELOPMENT RISKS
Snider, W.D., G.J. Buffleben, J.R. Harrald, K.F. Bishop, and J.C. Card. 1977.
Marine Technology 14(4):331-350.

Offshore exploration, Environmental management, Environmental protection, Gulf of Mexico, Oil discharges, Safety, Statistics, Atlantic Coast

Attention must be paid to identification, evaluation, and control of risks associated with mid-Atlantic offshore oil/gas production. A number of safety guidelines are presented, based on a statistical analysis of accidents, hazards, oil spills, and drilling mishaps. Tables present statistical data on these problems from drilling operations in the Gulf of Mexico.

C-0162-78
COLOR IT DANGEROUS
Worthington, V. 1977.
Conservation News 42(10):5-7.

Birds, Oil spills, Pollution control, Biological effects

Dr. Frank Heppner is advising a group of undergraduate students in a University of Rhode Island study to investigate the use of dyes as a method for keeping birds away from oil spills. If a spill can be dyed with a key avoidance color (orange seems to work for ducks), an inexpensive and readily applicable control method may be possible. Results are preliminary.

C. ASPECTS OF OIL POLLUTION

1. BIOLOGICAL ASPECTS

C-0163-78
BRIEF CONTACT WITH OIL HURTS FISH (news brief)
Anon. 1977.
Science News 112(24):392.

Contamination, Chronic effects, Fish, Oil spills, Blowouts, NOAA, Petroleum products

Recent studies by NOAA researchers S. Korn, N. Hirsch, and J. Struhsaker indicate that chronic exposures to low levels of petroleum hydrocarbons probably have more adverse effects than spills and blowouts. Their conclusions are based on laboratory studies of fish exposed to sublethal doses of benzene or toluene.

C-0164-78
FUEL OIL AND MARSH CRABS (news brief)
Anon. 1977.
Sea Technology 18(10):24.

Fuel oil, Marshes, Crustaceans, Mortality, Reproduction, Biological effects, Massachusetts

A salt marsh in Massachusetts was contaminated by No. 2 fuel oil in September 1969. Researchers report that concentrations of the oil as high as 1000 ppm still exist and that the crabs have as much as 280 ppm of oil in their body tissue. Crab mortality is high, and reproduction rates are lowered compared with control areas. The population is about one-tenth its normal level.

C-0165-78
OIL KILLS NORTH SEA BIRDS (news brief)
Anon. 1977.
Marine Pollution Bulletin 8(8):173.

Birds, Oil spills, Source identification, Mortality, North Sea, England

Two oil pollution incidents, one in February and one in April, 1977, have caused the death of several hundred birds. Along the shores of Bempton, Yorkshire, oil fingerprinting analysis has shown the February spill to consist of a fuel oil possibly of Nigerian origin, and the April spill to be a weathered crude oil similar to Middle East crudes. It appears that both spills were caused by illegal discharges from ships.

C-0166-78
OIL TESTS ON LOBSTERS AND SNAILS ARE UNSETTLING (news brief)
Anon. 1977.
National Fisherman 58(5):15B

Chronic effects, Oil spills, Behavior, Mollusks, Crustaceans, Chemical effects

Dr. Jelle Atema of the Boston University Marine Program at Woods Hole, Massachusetts, has concluded that the long-term effects of an oil spill can be more serious than the immediate damage encountered. Exposure to oil can confuse the behavior patterns vital to lobsters' and mud snails' survival because it seems that chemicals from oil interfere with the biological signals that induce eating and mating.

C-0167-78
EFFECTS OF PETROLEUM HYDROCARBONS ON THE RATE OF HEART BEAT AND HATCHING SUCCESS OF ESTUARINE FISH EMBRYOS
Anderson, J.W., D.B. Dixit, G.S. Ward, and R.S. Foster. 1977.
Physiological Responses of Marine Biota to Pollutants. Vernberg, F.J., A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). New York, Academic, 1977. p. 241-258. Proceedings of a Symposium, Milford?, Conn., 1975.

Mortality, Sublethal effects, Fish, Hydrocarbons, WSF, Fuel oil, Crude oil, *Hatching success

Higher mortality was seen in the estuarine fish *Cyprinodon variegatus*, *Fundulus heteroclitus*, and *F. simulus* exposed to water-soluble fractions (WSF) of No. 2 fuel oil than in those exposed to WSF of South Louisiana crude oil. When the WSF was renewed daily there were fewer survivors and the hatchability of eggs was significantly decreased. At 50% WSF concentration a 50% lower heart beat was recorded.

[from Chemical Abstracts 87(19): #146580g. 1977.]

C-0168-78
THE EFFECTS OF OIL ON LOBSTERS
Atema, J. 1977.
Oceanus 20(4):67-73.

Petroleum products, Sublethal effects, Mortality, Crustaceans, Contamination, **Homarus americanus*

Petroleum pollution can be very toxic to the Maine lobster, *Homarus americanus*. It can reduce the population as well as contaminate those used for human consumption. Study shows lobsters react in abnormal ways when exposed to hydrocarbons of varying intensities. Several types of oil were used to test reactions, which ranged from normal to spastic motor movements to death.

C-0169-78
SUBLETHAL EFFECTS OF PETROLEUM FRACTIONS ON THE BEHAVIOR OF THE LOBSTER, HOMARUS AMERICANUS, AND THE MUD SNAIL, NASSARIUS OBSOLETUS
Atema, J. 1976.
Estuarine Processes. M. Wiley (ed.). New York, Academic Press, 1976. Vol. 1:302-312. Proceedings of the 3rd International Estuarine Research Conference, held in 1975.

Fuels, Fuel oil, Crude oil, Hydrocarbons, Metabolism, Crustaceans, Mollusks, Marine organisms

Behavioral effects of kerosine, No. 2 fuel oil, crude oil, and water soluble fractions of each on the title organisms were studied. Certain hydrocarbon fractions, especially branched-cyclic, polar aromatic and soluble hydrocarbons in specific amounts appear to cause distinct behavioral changes.

[from Chemical Abstracts 87(15): #112538j. 1977.]

C-0170-78
TOXICITY OF WATER-SOLUBLE GASOLINE FRACTIONS TO FOURTH-INSTAR LARVAE OF THE MOSQUITO AEDES AEGYPTI L.
Berry, W.O., and J.D. Brammer. 1977.
Environmental Pollution 13(3):229-234.

Toxicity, Aromatic hydrocarbons, Gasoline, *Aedes aegypti

Laboratory experiments established a median lethal dose (LD_{50}) and a non-lethal dose (NLD) for these larvae following a 24 hour exposure to water-soluble fractions of benzene, toluene, and xylenes. Based on the amount which has actually gone into solutions, static toxicity bioassays showed that acute toxicity increases in the sequence benzene, toluene, xylenes. However, when data was examined based on the amount of aromatic added to produce the LD_{50}, toxicity increased in the sequence xylenes, benzene, toluene. Thus, the importance of concentration determinations is stressed.

C-0171-78
EFFECT OF PETROLEUM DEEMULSIFIERS ON CHIRONOMUS DORSALIS MEIG LARVAE [in Russian]
Bugaeva, L.N., and A.E. Shapshal. 1975.
Trudy Saratovskogo Otdeleniya GosNIORKh Vol. 13:184-186.

Toxicity, *Deemulsifiers, *Fly larvae, *Chironomus dorsalis

The petroleum deemulsifiers Dissolvan 4411-4422 and Dark Polymer were lethal to the title fly larvae in concentrations of 262-2625 mg/L and 19 mg/L, respectively. Chrysalis and adult stages of the fly were less sensitive. Maximum recommended doses for the two compounds should not exceed 52 mg/L and 1.9 mg/L, respectively.

[from Chemical Abstracts 87(17): #128281f. 1977.]

C-0172-78
A FOUR YEAR ANALYSIS OF VEGETATION FOLLOWING AN OIL SPILL IN A FRESHWATER MARSH
Burk, C.J. 1977.
Journal of Applied Ecology 14(2):515-522.

Oil spills, Biological effects, Plants, Sampling, Freshwater, Marshes, *Species reduction

Total plant cover and diversity measured by species richness, mean species per quadrant, and the Shannon-Wiener function were progressively reduced in both high and mid-marsh zones for two years after the spill. Eighteen of the species found before the spill were not found the season following. Perennial species tended to be less affected by the oil immediately following the spillage than annual species.

C-0173-78
A FOUR YEAR ANALYSIS OF VEGETATION FOLLOWING AN OIL SPILL IN A FRESHWATER MARSH
Burk, C.J. 1976.
Northampton, MA, Smith College, Dept. of Biological Sciences, 1976. Contract DI-14-31-0001-5021. 46 p.

Oil spills, Biological effects, Plants, Sampling, Freshwater, Marshes, *Species reduction

For summary see previous citation.

[from ERDA Energy Research Abstracts 2(16): #39242. 1977.]

C-0174-78
SEABIRD MORTALITY
Cobb, J.L.S. 1976.
Bird Study 23(4):299-300.

Birds, Contamination, Mortality, UK, *Seabirds

Figures for 1969-70 show a total kill of around 1,150 birds of which 220 were guillemots. Most of the dead birds were oiled as a result of an oil spill off the Tay Estuary. In 1970-74, the number of oiled birds did not exceed 60 in any year and no major spills were reported.

[from Biological Abstracts 64(4): #19805. 1977.]

C-0175-78
ACUTE TOXIC EFFECTS OF PETROLEUM ON ARCTIC AND SUBARCTIC MARINE ORGANISMS
Craddock, D.R. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 1-93.

Marine organisms, Toxicity, Acute effects, Arctic, Subarctic regions, *Bioassays

Literature on acute toxicity bioassay techniques using aquatic organisms is reviewed. Results of bioassays of petroleum relative to the toxicity of the various products tested and the sensitivity of the various marine organisms used are covered.

C-0176-78
EFFECTS OF WATER-SOLUBLE COMPONENTS OF PETROLEUM OILS AND AROMATIC HYDROCARBONS ON BARNACLE LARVAE
Donahue, W.H., R.T. Wang, M. Welch, and J.A.C. Nicol. 1977.
Environmental Pollution 13(3):187-202.

Petroleum products, Aromatic hydrocarbons, Toxicity, Mollusks, *Barnacles

The effects of eighteen aromatic hydrocarbons and S. Louisiana, Alaska, Kuwait, Venezuela crudes, Diesel fuel, Bunker C, No. 2 fuel oil, and crankcase oils on embryos and nauplii of barnacles were investigated. Development and hatching of embryos and the activity, phototaxis, and survival of larvae are included. Relative toxicities of the aromatics (in terms of percentages of saturated solutions) and of the oils are given.

C-0177-78
CYCLING OF POLLUTANTS
Duke, T.W. 1976.
Final Report EPA/600/J-76/068. 4 p.

Biological effects, Microorganisms, Fish

This introduction to a symposium of the same name emphasizes the impact of oil, heavy metals, and pesticides on ecosystems and on biological systems from micro-organisms to fishes.

[from Government Reports Announcements 77(19): #PB-268 572/5GA. 1977.]

C-0178-78
THE EFFECTS OF THE WATER-SOLUBLE FRACTIONS OF NO. 2 FUEL OIL ON THE EARLY DEVELOPMENT OF THE ESTUARINE FISH, *FUNDULUS GRANDIS* BAIRD AND GIRARD
Ernst, V.V., J.M. Neff, and J.W. Anderson. 1977.
Environmental Pollution 14(1):25-35.

Fuel oil, WSF, Hydrocarbons, Fish, Biological effects, Acute effects, *Embryo development, **Fundulus grandis*

Studies of the effects of petroleum pollution upon marine organisms generally concentrate on the adult members of the population. This investigation considered the effects of petroleum hydrocarbons on the early development of *Fundulus grandis* Baird and Girard. Embryonic *F. grandis* were exposed to 12.5, 25, and 50% dilutions of No. 2 fuel oil. Embryos exposed to the 12.5% solution were generally normal; those exposed to 25% had some pathological tissues; none of the embryos exposed to the 50% dilution hatched.

C-0179-78
SOME EFFECTS OF OIL DISPERSANTS ON THE FEEDING BEHAVIOR OF THE BROWN SHRIMP, *CRANGON CRANGON*
Evans, G.W., M. Lyes, and A.P.M. Lockwood. 1977.
Marine Behaviour and Physiology 4:171-181.

Dispersants, Biological effects, Crustaceans, Sublethal effects, **Crangon crangon*

Concentrations in the range 1 ppm-100 ppm of Tween 80, BP 1100X and Slickgone LT2 in seawater are shown to decrease both the food consumption of the shrimp and the ability of the animal to select the arm of a y-maze which contains food extract. The ability to locate food is largely recovered within 4 hr of return of the animals to clean seawater after prior exposure to 10 ppm of the above dispersants.

[from Selected Water Resources Abstracts 15(18): #W77-08790. 1977.]

C-0180-78
CONSEQUENCES OF OIL FOULING ON MARINE MAMMALS
Geraci, J.R. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 399-410.

Crude oil, Biological effects, Marine mammals, **Phoca hispida*

A controlled study was conducted on the behavioral, physiological and pathological consequences of crude oil contact on ringed seals, Phoca hispida. Results showed that up to 75 ml of ingested crude oil is not irreversibly harmful to seals, and that immersed seals ingest very small quantities. Surface contact with oil had a far greater impact on the seals than did absorption; eye damage was a significant finding in the field oil study.

C-0181-78

EFFECTS OF VARYING CONCENTRATIONS OF PETROLEUM HYDROCARBONS IN SEDIMENTS ON CARBON FLUX IN MYA ARENARIA

Gilfillan, E.S., D.W. Mayo, D.S. Page, D. Donovan, and S. Hanson. 1977.

Physiological Responses of Marine Biota to Pollutants. F.J. Vernberg, A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). New York, Academic Press, 1977. p. 299-314.

Hydrocarbons, Toxicity, Mollusks, Sediments, *Carbon flux, *Mya arenaria

An investigation begun in 1974 studied samples of M. arenaria and sediments from Casco Bay, Maine, which were contaminated to varying degrees during the 1972 Tamano oil spill. It was found that when dealing with low concentrations of highly weathered oils, total hydrocarbon content of either sediments or animal tissues are not sensitive measures of stress imparted to M. arenaria, whereas the carbon flux measurements used in this study are. The concentration of aromatic hydrocarbons in the clam tissues (significant as low as 3-4 ppm) correlated very closely with reductions in carbon flux and thus stress.

C-0182-78

INDUCTION OF HEPATIC ARYL HYDROCARBON HYDROXYLASE IN SALMON EXPOSED TO PETROLEUM DISSOLVED IN SEAWATER AND TO PETROLEUM AND POLYCHLORINATED BIPHENYLS, SEPARATE AND TOGETHER, IN FOOD

Gruger, E.H., Jr., M.M. Wekell, P.T. Numoto, and D.R. Craddock. 1977.

Bulletin of Environmental Contamination and Toxicology 17(5): 512-520.

Hydrocarbons, Crude oil, Fish, Sublethal effects, *Coho salmon

Hepatic aryl hydrocarbon hydroxylase (AHH) is induced in Coho salmon exposed to 1 ppm PCB's in the diet; however, comparable experiments with 1 ppm Prudhoe Bay crude oil did not alter the AHH activities. These findings suggest that in aquatic food chains containing petroleum hydrocarbons and PCB's, the latter substance may exert a predominant influence on the induction of the hepatic AHH enzyme system. Young Coho salmon exposed to 150 ppb of a seawater-soluble fraction of crude oil for 6 days exhibited a significant induction of this enzyme system. Thus, highly soluble crude oil components may be more effective than high molecular weight insoluble components in inducing AHH.

C-0183-78
EFFECT OF PETROLEUM DEEMULSIFIERS ON THE EMBRYONIC AND POST-EMBRYONIC DEVELOPMENT OF STARRED STURGEON [in Russian]
Gurova, G.V. 1975.
Trudy Saratovskogo Otdeleniya GosNIORKh Vol. 13:176-181.

Toxicity, Fish, Development, *Starred Sturgeon, *Deemulsifiers, *Growth

"Dark polymer petroleum deemulsifier was more toxic (maximum permissible limit <1mg/L) to sturgeon in the roe, pecking out, and prelarval stages than was Dissolvan 4411-4422 or Neutralized Black Contact. The prelarval stage was the most sensitive. All 3 deemulsifiers damaged the cardiovascular and nervous system."

[from Chemical Abstracts 87(17): #128280e. 1977.]

C-0184-78
SALT MARSH GRASSES AND #2 FUEL OIL
Hampson, G.R., and E.T. Moul. 1977.
Oceanus 20(4):25-30.

Oil spills, Fuel oil, Marshes, Restoration, Sediments, Massachusetts, *Marsh grasses

In October 1974, the barge Bouchard No. 65 hit a submerged object in Buzzards Bay, Massachusetts and spilled an undetermined amount of No. 2 fuel oil. The marsh grass community was heavily damaged and three years later shows a progressive hesitancy to regeneration and re-establishment. The peat substrate shows high concentrations of petroleum hydrocarbons, and compared to an unpolluted area, erosion rates are as much as 24 times higher than in the spill area.

C-0185-78
MARINE FISH AND INVERTEBRATE DISEASES, HOST DISEASE RESISTANCE, AND PATHOLOGICAL EFFECTS OF PETROLEUM
Hodgins, H.O., B.B. McCain, and J.W. Hawkes. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 95-173.

Fish, Invertebrates, Biological effects, Hydrocarbons, *Disease, *Disease resistance

The chapter is divided into 3 topics of discussion: 1.) review of the principal known diseases of arctic and subarctic fish and invertebrate species; 2.) disease resistance mechanisms of vertebrates and invertebrates and environmental factors affecting disease and disease resistance; and 3.) effects of petroleum on disease and disease resistance.

C-0186-78
ACUTE AND CHRONIC EFFECTS OF PETROLEUM ON MARINE BIRDS
Holmes, W.N., and J. Cronshaw. 1977.
The Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 359-398.

Birds, Oil spills, Acute effects, Chronic effects, Mortality, *Ducks

Topics covered in this chapter include: effects of spillage on mortality; physical systemic effects; and pathological effects. Studies indicate that mature ducks maintained under laboratory conditions tolerate well the chronic administration of at least two crude oils and one petroleum distillation product. Histological patterns of the adrenal gland in birds treated with oil, however, suggest a higher than normal level of adrenocortical function occurs under conditions of chronic petroleum ingestion. The development of this condition may account for the high mortality in experiments in which birds fed oil-contaminated diets were exposed to cold-stress.

C-0187-78
BIOELECTRIC ACTION POTENTIALS OF PROCAMBARUS ACUTUS ACUTUS (GIRRARD) IN SERIALLY DILUTED SOLUTIONS OF SELECTED C_6 HYDROCARBONS IN WATER
Idoniboye-Obu, B. 1977.
Environmental Pollution 14(1):5-24.

Hydrocarbons, Crustaceans, Acute effects, *Lethal thresholds, *Procambarus acutus acutus

The principle of recording neurogenic and myogenic biopotentials by using remote electrodes in water containing petroleum hydrocarbons is explored. Lethal thresholds of water pollution could be set using the method described, with a minimum sacrifice of the title laboratory animals.

C-0188-78
SUBLETHAL BIOLOGICAL EFFECTS OF PETROLEUM HYDROCARBON EXPOSURES: BACTERIA, ALGAE, AND INVERTEBRATES
Johnson, F.G. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 271-318.

Hydrocarbons, Sublethal effects, Bacteria, Algae, Invertebrates, Behavior, *Chemoreception

Literature is summarized and assessed with respect to the sublethal effects of petroleum hydrocarbon exposures on physiology, behavior, growth, development and reproduction of marine bacteria, algae, and invertebrates. Invertebrate chemoreception and behavior are the main focus of the review, as these processes appear to be especially sensitive to small amounts of oil.

C-0189-78
THE EFFECT OF OILY WATER DISCHARGES ON MARINE ORGANISMS IN THE CONTEXT OF NORTH SEA OIL DEVELOPMENTS
Johnston, R., and A.D. McIntyre. 1977.
The Separation of Oil from Water for North Sea Operations. Edinburgh, UK, Institute of Offshore Engineering, Heriot-Watt University, 1977. p. 15-36. Proceedings of Seminar, June 22-23, 1976.

Offshore development, Oil discharges, Biological effects, Plants, Plankton, Marine organisms, North Sea

Recent major oil spills, coupled with expanding North Sea oil development, have caused research efforts to focus on the effects of oil on marine organisms. This paper reviews recent work on the effects of oil on macrophytic plants, phytoplankton, other microorganisms, and marine animals, especially mollusks and crustaceans.

C-0190-78
CHANGE IN THE NUMBER OF ZOOPLANKTON UNDER THE EFFECT OF PETROLEUM POLLUTANTS AND DISPERSANTS [English summary]
Koroleva, A.M. 1977.
Vestnik Moskogovskogo Universiteta, Seriya 16:Biologiya No. 1: 30-33.

Fuels, Lubricating oil, Dispersants, Zooplankton, Toxicity

Addition of diesel fuel, motor oil, and two dispersants to a body of water caused a decrease in the number of zooplankton growing therein. Toxicity increased directly with concentration and length of exposure. The dispersant Corexit was more toxic than diproxamine, and diesel fuel was more toxic than motor oil. Dispersants did not decrease the toxicity of the petroleum products to the organisms.

[from Chemical Abstracts 87(15): #112620e. 1977.]

C-0191-78
CONTROLLED ECOSYSTEMS: THEIR USE IN THE STUDY OF THE EFFECTS OF PETROLEUM HYDROCARBONS ON PLANKTON
Lee, R.F., M. Takahashi, J.R. Beers, W.H. Thomas, et al. 1977.
Physiological Responses of Marine Biota to Pollutants. F.J. Vernberg, A. Calabrese, F. P. Thurberg, and W.B. Vernberg (eds.). New York, Academic Press, 1977. p. 323-342.

Fuel oil, Biological effects, Plankton, Biodegradation

In this controlled ecosystem pollution experiment (CEPEX), No. 2 fuel oil was added to a 60,000 L enclosure and the effects on species composition and standing stock of phytoplankton, microzooplankton, and zooplankton were studied. Chlorophyll, nutrients, and photosynthetic productivity were also measured. The authors speculate that the only direct effects of petroleum were on the phytoplankton. The observed decrease in hydrocarbon concentration of the water was attributed to biodegradation and adsorption to sinking particles.

C-0192-78
CONTROLLED ECOSYSTEMS: THEIR USE IN THE STUDY OF THE EFFECTS OF PETROLEUM HYDROCARBONS ON PLANKTON
Lee, R.F., M. Takahashi, J.R. Beers, W.H. Thomas, and D.L.R. Seibert. 1977.
NSF/IDOE-77-73, Grants NSF-GX-39149, NSF-ID073-09761-A01. 25 p.

Fuel oil, Biological effects, Plankton

For summary, see previous citation.

[from Government Reports Announcements 77(18): #PB-267 704/5GA. 1977]

C-0193-78
SOME LABORATORY CULTURED CRUSTACEANS FOR MARINE POLLUTION STUDIES
Lee, W.Y. 1977.
Marine Pollution Bulletin 8(11):258-259.

Petroleum products, Waste oil, Crustaceans, Toxicity, Intertidal zone, *Laboratory cultures

Three crustaceans, Acartia tonsa, Sphaeroma quadridentatum, and Amphithoe valida are suggested for use in laboratory toxicity tests in oil pollution research. These organisms, obtained from the intertidal zone where oil spills and oil-contaminated waste occur most frequently, are easy to culture for research purposes. Instructions for culturing these animals in the laboratory are given.

C-0194-78
A GENETIC LOOK AT FISH EGGS AND OIL
Longwell, A.C. 1977.
Oceanus 20(4):46-58.

Argo Merchant spill, Fish, Mortality, *Nantucket Shoals, *Cod, *Pollock, *Fish eggs

Shortly after the grounding of the Argo Merchant, cod and pollock eggs were collected nearby, and examined for oil contamination.

Death and mutation resulted; however, total impact on fisheries is estimated to be small. Fewer cod eggs were fouled than pollock eggs (60% vs. 90%).

C-0195-78
EFFECTS OF POLLUTANTS ON AQUATIC ORGANISMS (book review)
Lutz, P. 1977.
Bulletin of Marine Science 27(2):352.

Biological effects, Marine organisms, Hydrocarbons, Sublethal effects

The title book [A.P.M. Lockwood (ed.). New York, Cambridge University Press, 1976. 193 p. (Society for Experimental Biology Series 2)] is reviewed. The book's main concern is with sublethal effects and most articles are of a review or discussive nature, with a few single subject papers. There is a comprehensive review of "Hydrocarbons in zooplankton and fish."

C-0196-78
THE EFFECT OF PURE OIL SUBCOMPONENTS ON MYTILUS EDULIS, THE BLUE MUSSEL
Major, C.W. 1977.
Physiological Responses of Marine Biota to Pollutants. F.J. Vernberg, A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). New York, Academic Press, 1977. p. 315-322.

Hydrocarbons, Toxicity, Mollusks, Respiration, *Mytilus edulis

Samples of M. edulis were collected from the Gulf of Maine for this laboratory study. The parameters studied were change in respiration and byssal thread formation. The effects of benzene, hexane, naphthalene, and two concentrations of benzene and naphthalene are discussed.

C-0197-78
THE ACCUMULATION OF CHLORINE-LABELLED DISPERSED BUNKER C IN VARIOUS FISH TISSUES
McKeown, B.A. and G.L. March. 1977.
Spill Technology Newsletter 2(3):27-31.

Fuel oil, Hydrocarbons, Dispersants, Toxicity, Chemical analysis, Fish, Uptake, *Oil-dispersant mixture

The theory that hydrocarbons combined with oil dispersants are more toxic to marine organisms than hydrocarbons alone was tested. Chlorine-labelled Bunker C oil was used to test differential accumulation in trout tissues. The oil/dispersant mixture showed some increased movement through some tissues. The results are discussed with consideration of such factors as blood transport ability, tissue accumulation, and permeability.

C-0198-78

CRUDE OIL INGESTION IMPAIRS OSMO REGULATORY AND NUTRIENT TRANSPORT IN HERRING GULLS

Miller, D.S., D.B. Peakall, and W.B. Kinter. 1977.

Federation Proceedings 36(3):1008. Federation of American Societies for Experimental Biology, 61st Annual Meeting, Chicago, 1977.

Crude oil, *Ingestion, Birds, *Osmoregulation, *Herring gulls

Summary not available.

C-0199-78

ASSIMILATION OF LIQUID HYDROCARBON BY MICROORGANISMS: I. MECHANISM OF HYDROCARBON UPTAKE

Miura, Y., M. Okazaki, S.-I. Hamada, S.-I. Murakawa, and R. Yugen. 1977.

Biotechnology and Bioengineering 19(5):701-704.

Hydrocarbons, Uptake, Microorganisms, *Adhesion

The microorganisms Candida lipolytica, C. tropicalis, C. intermedia, and Saccharomyces cerevisiae were used to investigate the uptake mechanism of liquid hydrocarbons of low solubility in water. "Microorganisms which could utilize hydrocarbon were much more adherent to hydrocarbon than those which could not." The total hydrocarbon uptake from dissolved hydrocarbon was much lower than that from drop and accomodation forms of hydrocarbons.

[from Biological Abstracts 64(4): #20403. 1977.]

C-0200-78

ASSIMILATION OF LIQUID HYDROCARBON BY MICROORGANISMS: II. GROWTH KINETICS

Miura, Y., M. Okazaki, S.-I. Murakawa, S.-I. Hamada, and K. Ohno. 1977.

Biotechnology and Bioengineering 19(5):715-726.

Hydrocarbons, Uptake, Microorganisms, *Growth kinetics

Investigation of the growth kinetics of Candida intermedia IFO 0761 showed that the microorganism contained a hydrocarbon pool in and/or on the cell. "The transfer of water-soluble substrates to the cell was not the rate-limiting step in the growth of C. intermedia accompanied by clump formation with liquid hydrocarbon ." The specific growth rate was expressed mathematically.

[from Biological Abstracts 64(4): #20404. 1977.]

C-0201-78
THE TOXIC EFFECTS OF HYDROCARBONS UPON THE NAUPLIAR AND ADULT STAGES OF *BALANUS* (CRUSTACEA:CIRIPEDIA)
Morton, B., and R.S.S. Wu. 1977.
Marine Pollution Bulletin 8(10):232-236.

Hydrocarbons, Petroleum products, Toxicity, Crustaceans, **Balanus*

This study investigates 1) the comparative toxicity of 4 hydrocarbons (BP1002, Chemkleen, Bukomkleen, and kerosene), and 2) the effect of an oil spill remover (BP1002) and kerosene upon the naupliar and adult stages of *Balanus amphitrite amphitrite* and *Balanus variegatus variegatus*. Results showed BP1002 to be the most toxic; Chemkleen and Bukomkleen had a lower and similar toxicity; and kerosene had a comparatively low toxicity. The percentage non-motility and actual mortality of both stages of the barnacles is a function of the dosage and treatment time of BP1002 and kerosene. Both species have a similar susceptibility to the hydrocarbons tested, with the nauplii being killed at lower concentrations than the adults.

C-0202-78
DATA ON THE SUBSTANTIATION OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF NAPHTHALENE FOR FISHERY WATER BODIES [English summary]
Mosevich, M.V., N.M. Arshanitsa, L.V. Glukhova, I.G. Grigor'eva, *et al*. 1976.
Izvestiya Gosudarstvennogo Nauchno-Issledovatel'skogo Instituta Ozernogo i Rechnogo Rybnogo Khozyaistva Vol. 109:50-57.

Hydrocarbons, Fisheries, *Naphthalene, *Maximum permissible concentration

"The maximum permissible concentration of naphthalene in fishery water bodies is 0.004 mg/L."

[from Chemical Abstracts 87(18): #140967s. 1977.]

C-0203-78
TUMORS AND AMYLOIDOSIS IN MICE PAINTED WITH CRUDE OIL FOUND ON BATHING BEACHES
Nea, B., and M. Wolman. 1977.
Bulletin of Environmental Contamination and Toxicology 18(3): 385-391.

Crude oil, Biological effects, *Mice, Beaches, Israel, Health hazards

Oil lumps originating from crude oil spills were collected on the beaches of Israel in 1970, 1971, and 1973, extracted with pure acetone, and the extracts were painted on the skin of mice twice weekly for 12 months. The older oils induced amyloidosis and some papillomata and lymphomata. Discussion includes the possibility that acetone and oil might act synergistically or antagonistically at different phases of amyloidogenesis. Results cannot be easily extrapolated to human experience.

C-0204-78

EFFECTS OF OIL ON MICROBIAL COMPONENT OF AN INTERTIDAL SILT-SEDIMENT ECOSYSTEM

Norrell, S.A., and M.H. Johnston. 1976.
Assessment of the Arctic Marine Environment: Selected Topics. D. W. Hood and D. C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 305-327. (Occasional Publication No. 4.)

Crude oil, Sediments, Bacteria, Intertidal zone, Biological effects, Biodegradation, Alaska, *Port Valdez

Fundamental relationships between bacterial biomass and sediment properties are reviewed with emphasis on the characteristics of a glacial silt intertidal zone near the Port Valdez pipeline terminal. Bacterial population data and respirometry data were used to estimate standing crop and activity response of microbial populations to oil contamination. Sulfur-cycle bacteria were also examined because of their known association with both marine environments and oil deposits.

C-0205-78

SUBLETHAL BIOLOGICAL EFFECTS OF PETROLEUM HYDROCARBON EXPOSURES: FISH

Patten, B.G. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 319-335.

Hydrocarbons, Sublethal effects, Fish, Arctic, Subarctic regions

The objective of this review is to present information on the behavioral and physiological responses of marine fishes to petroleum hydrocarbons at sublethal concentrations. Of major concern are marine fishes indigenous to arctic and subarctic waters, although, due to the unavailability of this information, data on organisms from other geographic environments are included.

C-0206-78

DISTRIBUTION AND ABUNDANCE OF WATERFOWL WINTERING IN SOUTHERN QUEBEC

Reed, A., and A. Bourget. 1977.
Canadian Field Naturalist 91(1):1-7.

Birds, Distribution, Habitat, Biological effects, Canada, St. Lawrence River

Surveys of wintering waterfowl in January and February of 1974, 1975, and 1976 indicated the presence of at least 171,000 ducks in the estuary and Gulf of St. Lawrence. "Further study and close surveillance are required owing to the birds' apparently great vulnerability to oil pollution and habitat change in a very rigorous climate."

[from Biological Abstracts 64(4): #19809. 1977.]

C-0207-78

SOME METABOLIC EFFECTS OF PETROLEUM HYDROCARBONS IN MARINE FISH

Sabo, D.J., and J.J. Stegeman. 1977.

Physiological Responses of Marine Biota to Pollutants. F.J. Vernberg, A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). New York, Academic Press, 1977. p. 279-287.

Fuel oil, Contamination, Toxicity, Chronic effects, Fish, Marshes, *Biochemical changes

Fundulus heteroclitus were collected from a chronically oil-exposed marsh and a control uncontaminated marsh. Results show that 1) petroleum hydrocarbon contamination does produce subtle biochemical changes in fish that are both briefly and chronically exposed; and 2) these changes indicate an altered membrane structure either intracellularly or at the cell surface. Further research is being conducted on the meaning of these changes as they relate to membrane function or the health or reproduction of the population of these fishes.

C-0208-78

TOXICITY AND METABOLISM OF NAPHTHALENE: A STUDY WITH MARINE LARVAL INVERTEBRATES

Sanborn, H.R., and D.C. Malins. 1977.

Proceedings of the Society for Experimental Biology and Medicine 154(2):151-155.

Hydrocarbons, Toxicity, Metabolism, Crustaceans, *Naphthalene, *Larvae

"[1-^{14}C]Naphthalene and [1-^{14}C]naphthalene complexed with BSA [bovine serum albumin] at 8-12 ppb in flowing sea water produced 100% mortality in 24-36 h in newly hatched Dungeness crab (Cancer magister) zoea and stage I and V spot shrimp (Pandalus platyceros)." Measurements of accumulation and metabolic products are given.

[from Biological Abstracts 64(8): #48065. 1977.]

C-0209-78

THE WEST FALMOUTH SPILL — FLORIDA, 1969

Sanders, H.L. 1977.

Oceanus 20(4):15-24.

Fuel oil, Oil spills, Marine organisms, Benthos, Mortality, Biological effects, Massachusetts

In September, 1969, the barge Florida ran aground, spilling No. 2 fuel oil into Buzzards Bay, Massachusetts. The results of an investigation of the impact of oil on the bottom-dwelling marine life are given. Many organisms died upon oil contact, and an explosive population increase of Capitella capitata (a polychaete) occurred. Floral and faunal densities, in relation to degree of concentration of oil, were studied, and the results given. Seven years after the spill, total effects are not known.

C-0210-78
USE OF UNICELLULAR ALGAE FOR EVALUATION OF POTENIAL AQUATIC CONTAMINANTS
Scherfig, J., P. Dixon, C. Justice, and R. Appleman. 1977.
Report No. 1 (Annual) for 1 Sept - 31 May 76. AMRL-TR-76-65, Contract F33615-76-C-5005. 28 p.

Algae, Fuels, Toxicity, *Hydrazines, *Lubricant additives, *Jet engine fuels

The toxic and/or biostimulating effect of lubrication additives and hydrazines in aquatic environments was determined for the test alga Selenastrum capricornutum. Results indicate the relative and absolute toxicity of the compounds tested under standard laboratory conditions.
[from Government Reports Announcements 77(19): #AD-A041 565/3GA. 1977.]

C-0211-78
PATHOMORPHOLOGICAL CHANGES IN CARP ORGANS UNDER THE EFFECT OF PETROLEUM DEMULSIFIERS [in Russian]
Shcherbakov, Yu.A., N.N. Lizina, and N.G. Chernova. 1975.
Trudy Saratovskogo Otdeleniya GosNIORKh Vol. 13:187-190.

Toxicity, Fish, Metabolism, *Deemulsifiers, *Carp organs, *Morphological changes

"When added to water at 0.8-3.3 g/L and 6-25 mg/L, respectively, two deemulsifiers from petroleum, Dissolvan 4411-4422 and Dark Polymer, disrupted metabolism and caused dystrophic changes in the parenchymatous organs, hyperemia, and edema in carp."

[from Chemical Abstracts 87(17): #128282g. 1977.]

C-0212-78
DISTRIBUTION AND ECOLOGY OF THE HERMIT CRAB CLIBANARIUS ERYTHROPUS IN THE WESTERN CHANNEL
Southward, A.J., and E.C. Southward. 1977.
Journal of the Marine Biological Association of the United Kingdom 57(2):441-452.

Surfactants, Toxicity, Crustaceans, Distribution, UK, *Clibanarius erythropus

The ecological niche and distribution limits of *C. erythropus* are discussed. In 1967, toxic 'oil-spill removers' killed half of the known population of *Clibanarius* in Cornwall. The crab has not returned to the affected shores and seems to be declining in other areas.
[from Biological Abstracts 64(7): #37572. 1977.]

C-0213-78
FATE AND EFFECTS CF OIL IN MARINE ANIMALS
Stegeman, J.J. 1977.
Oceanus 20(4):59-66.

Hydrocarbons, Toxicity, Marine organisms, Sublethal effects, Chronic effects, Uptake, Release

Oil spill damage to marine animals affects man through immediate loss of marketable food resources, long-term loss of species, or a toxic hazard. Effects are determined by summated chronic and sublethal effects of hydrocarbons on primary producers and the rest of the food chain. Uptake of petroleum hydrocarbons is a general phenomenon; depuration varies greatly and causes the greatest impact. Toxicological studies assist in determining the effects of hydrocarbons on specific animals, but are difficult to confirm, as many complexities in field and laboratory experiments compound the problem.

C-0214-78
EFFECTS OF NATURAL CHRONIC EXPOSURE TO PETROLEUM HYDROCARBONS ON SIZE AND REPRODUCTION IN *MYTILUS CALIFORNIANUS* CONRAD
Straughan, D. 1977.
Physiological Responses of Marine Biota to Pollutants. F.J. Vernberg, A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). New York, Academic Press, 1977. p. 289-298.

Natural seepage, Chronic effects, Mollusks, Reproduction, Southern California, *Size

Samples of *M. californianus* were collected from an area of natural chronic exposure to petroleum — Coal Oil Point, California — and from two uncontaminated areas to study reproduction and size differences. The study showed no differences in those parameters that could be attributed to the effects of natural chronic exposure to petroleum. The total ether extractables from the Coal Oil Point, Pismo Beach, and Santa Catalina mussels were 130-435, 4-26, and 2-7 μg/g, with 95% of the Coal Oil Point extractables of petroleum origin.

C-0215-78

TOXIC EFFECTS OF MILITARY WASTEWATER EFFLUENT

Sweazy, R.M., F.L. Rose, and C.L. Bough. 1977.
Report AD-A038795. 80 p.

PAH, Toxicity, Fuel oil, Wastewater treatment, Lakes, *Salamanders, *Diesel oil, *Asphalt

Tiger salamanders (*Ambystoma tigrinum*) living in a playa lake which received treated domestic sewage were found to have a high incidence of tumors. Analysis showed the causative agents to be PAH from diesel oil and asphalt which had been applied to the lake. Tumor incidence was not affected by conventional wastewater treatment.

[from Chemical Abstracts 87(18): #140610v. 1977.]

C-0216-78

RELATIONSHIP OF SCARLET PRAWNS (*PLESIOPENAEUS EDWARDSIANUS*) TO A BENTHIC OIL DEPOSIT OFF THE NORTH-WEST COAST OF ARUBA, DUTCH WEST INDIES

Thompson, H.C., Jr., R.N. Farragut, and M.H. Thompson. 1977.
Environmental Pollution 13(4):239-254.

Hydrocarbons, Crustaceans, Benthos, Distribution, Metabolism, **Plesiopenaeus edwardsianus*, *N-parafins

Sampling showed a greater catch rate of crustacea (scarlet prawns were three times more abundant) in areas where benthic oily material was collected as compared to adjacent unpolluted areas. The prawns contained an unusual n-paraffin hydrocarbon series (n-C_{22}, n-C_{25}, n-C_{28}, n-C_{31}, n-C_{34}) which was in higher quantities in prawn over the oily area. Discussion includes a probable explanation for the crustacea distribution and a description of accumulation and metabolism of hydrocarbons by marine organisms.

C-0217-78

METABOLISM OF PETROLEUM HYDROCARBONS: ACCUMULATION AND BIOTRANSFORMATION IN MARINE ORGANISMS

Varanasi, U., and D.C. Malins. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 175-270.

Hydrocarbons, Uptake, Metabolism, Release, Marine organisms, Sublethal effects, *Biochemical changes

Included is a discussion of the uptake, metabolism, and discharge of petroleum hydrocarbons in marine organisms exposed to sublethal levels of petroleum. Resultant biochemical alterations in exposed organisms are also examined. Major emphasis is placed on laboratory bioassay studies on simulated field experiments. The status of knowledge on these subjects and areas where more research is needed are delineated.

C-0218-78
PHYSIOLOGICAL RESPONSES OF MARINE BIOTA TO POLLUTANTS
Vernberg, F.J., A. Calabrese, F.P. Thurberg, and W.B. Vernberg (eds.). 1977.
New York, Academic Press, Inc., 1977. 482 p.

Contaminants, Marine organisms, Petroleum products, Biological effects, *Physiological response

Papers at a symposium on physiological responses of marine biota to pollutants are presented. Pollutants covered include pesticides, PCB's, heavy metals, and petroleum products.

[from Marine Biology 39(4):advertisement. 1977.]

C-0219-78
EFFECTS OF FUEL OIL ON SEA CATFISH: FEEDING ACTIVITY AND CARDIAC RESPONSES
Wang, R.T., and J.A.C. Nicol. 1977.
Bulletin of Environmental Contamination and Toxicology 18(2): 170-176.

Toxicity, Fuel oil, Fish, *Arius felis

The effects of a No. 2 fuel oil on survival, feeding behavior, and heart rate of Arius felis (L.) were studied. At concentrations >0.08 ml L^{-1}, fuel oil was lethal; the LC_{50} for 96 hr was 0.14 ml L^{-1}. Similar research is reviewed and compared.

C-0220-78
THE BALTIC SEA POLLUTION
Zmudzinski, L. 1975.
Polskie Archiwum Hydrobiologii Vol. 22:601-614.

Hydrocarbons, Contamination, Biological effects, Crustaceans, Bacteria, Biodegradation, Baltic Sea

Eutrophication and hydrocarbon contamination of the Baltic Sea were studied between 1971-1973. It was apparently impossible to determine petrochemical concentrations, but the increasing degree of pollution was acknowledged due to indirect observations of declining seabird populations. The most sensitive bioindicators of hydrocarbons are some species of crustaceans, and benthic fishes are the least sensitive. Flavobacterium species were found to be the most active biodegraders of fuel oils, but their activity decreases with decreasing temperature and increasing hydrocarbon concentrations.

C-0221-78
ACCUMULATION OF BENZ(A)PYRENE BY SOME BLACK SEA ORGANISMS UNDER EXPERIMENTAL CONDITIONS
Zobova, N.A., L.G. Solenova, N.D. Mazmanidi, and A.P. Il'nitskiy.
1976.
Oceanology 16(3):259-261.

Uptake, PAH, Carcinogens, Fish, Mollusks, Black Sea

The mussel, *Mytilus galloprovincialis*, the whiting, *Odontogadus merlangus*, and the pickerel, *Spicara smaris*, were exposed to this carcinogen at about 0.01 and 0.1 μg/L of seawater for 96 hr. The mussels but not the fish accumulated the compound. The gall bladder was the principal site of benz(a)pyrene accumulation.

[from Oceanic Abstracts 14(4): #77-03582. 1977.]

2. PHYSICAL ASPECTS

C-0222-78
THE EFFECT OF OIL POLLUTION OF SEA SURFACE ON CHARACTERISTICS OF RADIOLOCATION SIGNALS REFLECTED AT SMALL SLIP ANGLES [in Russian]
Bol'shakov, A.N., Iu.M. Galaev, V.B. Efimov, A.I. Kalmykov, *et al*.
1976.
Morskie Gidrofizicheskie Issledovaniia, No. 4:175-189.

Oil slicks, Sea surface, *Radiolocation signals

"Radiolocation reflections from sections of the sea surface covered with an oil slick were measured at 3 and 10 cm with small slip angles (0.5 and 3.0 deg)." Results showed that an oil film with an average thickness of 0.1μ reduced the signal by 20 dB or more at the 3 cm band and by 15 dB or more at 10 cm. Parameters of the apparatus are discussed.

[from International Aerospace Abstracts 17(19): #A77-40822. 1977.]

C-0223-78
THE DEFLECTION OF AN ICE SHEET BY A SUBMERGED GAS SOURCE
Topham, D.R. 1977
Journal of Applied Mechanics 44(2):279-284.

Blowouts, Ice, Behavior, Models, *Ice sheet deflection, *Submerged gas source

The deflection of an infinite ice sheet by a submerged gas source, such as an undersea gas or oil well blowout, is analyzed using an elastic thin-plate model. Fracture may occur at the bubble center or just beyond the bubble edge depending on bubble depth, ice thickness, and mechanical properties of the ice sheet. Prediction of the actual bubble radius required to cause failure is not certain as the critical bubble radius is very sensitive to these parameters.

[from Chemical Abstracts 87(18): #138134z. 1977.]

3. CHEMICAL ASPECTS

C-0224-78
ENVIRONMENTAL CHEMISTRY
Bockris, J.O'M. (ed.). 1977.
New York, Plenum Press, 1977. xi + 795 p.

Chemical analysis, Chemical effects, Contamination

This book contains 23 chapters on various aspects of the title subject. Two chapters concern oil pollution: Chapter 12, the Chemistry of Water Pollution, T. Mullins; and Chapter 13, Organic Chemical Pollution: Petroleum, Pesticides, and Detergents, H.S. Stoker and S.L. Seager.

C-0225-78
NITROGEN FIXATION IN ARCTIC MARINE SEDIMENTS: EFFECT OF OIL AND HYDROCARBON FRACTIONS
Knowles, R., and C. Wishart. 1977.
Environmental Pollution 13(2):133-149.

Hydrocarbons, Crude oil, Sediments, Canada, *N fixation

Measurements were taken of N fixation (acetylene reduction) in grab and core samples of sediments from the Beaufort Sea and Eskimo Lakes, NT, Canada. There was no stimulatory or inhibitory effect on N fixation or CO_2 evolution with weathered Norman Wells crude oil, hexane, dodecane, or hexadecane. Complete inhibition of N fixation and partial inhibition of CO_2 evolution occurred in the presence of 1,2,4-Trimethylbenzene. There was no evidence of hydrocarbon utilization during periods of over 30 days.

[from Biological Abstracts 64(8): #43963. 1977.]

C-0226-78
THE CHEMISTRY OF WATER POLLUTION
Mullins, T. 1977
Environmental Chemistry. J. O'M. Bockris (ed.). New York and London, Plenum Press, 1977. p. 331-400.

Chemical effects, Dispersions, Toxicity, Spreading

This chapter is broken into sections which cover the following aspects: historical, background, pollutants, water structures, reactive sites, metals, gases, nutrients, and organic compounds. A brief discussion of oil pollution stresses the need to remove spilled oil as quickly as possible as dispersed oil is more toxic to aquatic life than a slick. Chemical and physical reactions of the oil as it spreads and degrades are mentioned, including the capacity of oil to concentrate heavy metals and pesticides.

C-0227-78
THE COMPOSITION OF OIL — A GUIDE FOR READERS
Ryan, P.R. 1977.
Oceanus 20(4):4.

Hydrocarbons, Toxicity, Sources, Chemical analysis, *Alkanes, *Cycloalkanes, *Aromatics

This guide was written to inform readers of the history, formation, source, and chemical composition of oil. The three hydrocarbon classes (alkanes, cycloalkanes, and aromatics) are defined in detail. The boiling point of various petroleum products is given in a table and the article closes with a discussion of toxicity.

4. ECONOMIC ASPECTS

C-0228-78
TAXPAYERS MAY EAT COST OF OIL BARGE DAMAGE (news brief)
Frye, J. 1977.
National Fisherman 58(6):24-B.

Economic effects, Liability, Oil spills, Birds, Beaches, Environmental effects, Chesapeake Bay

American taxpayers may pay over $1/L ($5/gal) for the 946,000 L (250,000 gal) of heavy No. 6 fuel oil spilled from a Steuart Transportation Co. barge into the Chesapeake Bay February 2, 1976. A cost analysis was conducted by the office of the US Comptroller General, which included the killing of 31,000 seafowl and the cleanup of 44 km (27 mi) of Eastern Shore beaches and marshes. No money has been collected from Steuart Transportation or from Allied Towing Co. of Norfolk (owner of the tug involved), and suits have been filed against Steuart. The scope of environmental damage and human error involved in the spillage are discussed.

5. GENERAL ASPECTS

C-0229-78
OIL SPILLS (news brief)
Anon. 1977.
Audubon 79(5):154-155.

Chesapeake Bay, Argo Merchant spill, Birds, Economic effects, Cost analysis

The article details the General Accounting Office (GAO) report to Congress itemizing the losses attributed to two oil spills. The Chesapeake Bay spill of February 1976 cost $1.2 million and the Argo Merchant spill cost over $5 million, excluding the lost cargo valued at $2.4 million. A brief description of some of the environmental damage is included.

C-0230-78
THE BIOGEOCHEMISTRY OF OIL IN THE OCEAN
Farrington, J.W. 1977.
Oceanus 20(4):5-14.

Oil spills, Sources, Petroleum products, Crude oil, Sludge, Biological effects, Fate

Biogeochemistry covers many areas of study on oil pollution. The history of research into the sources, amounts, and fate of the world's oil pollution is briefly reviewed. A description of research projects in Buzzards Bay, Massachusetts, is provided. New York Bight sewage sludge, particularly as it pertains to hydrocarbon content, is discussed. Future research areas are discussed, and the value of research in oil pollution is summarized.

C-0231-78

MASS STRANDING OF THE LONG-FINNED PILOT WHALE, *GLOBICEPHALA MELAENA* ON SABLE ISLAND, NOVA SCOTIA

Geraci, J.R., and D.J. St. Aubin. 1977.
Journal of the Fisheries Research Board of Canada 34(11):2196-2199.

Marine mammals, *Argo Merchant* spill, *Newfoundland, *Whales, **Globicephala melaena*

In late December, 1976, a herd of over 130 long-finned pilot whales became stranded on Sable Island and there were implications in the news media that the stranding was precipitated by the December 15, 1976 grounding and breakup of the oil tanker *Argo Merchant*. Examination of the whales and hydrocarbon analyses of their skin and blubber tissues indicated that any causal relationship bewteen the stranding and the spill incident some 640 km (400 mi) distant is extremely unlikely.

C-0232-78

MARINE POLLUTION

Goldberg, E.D. 1976.
Chemical Oceanography. J.P. Riley and G. Skirrow (eds.). New York, Academic Press, 1976. Vol. 3. p. 39-89.

Environmental effects, Biological effects, Oil discharges, Petroleum products, Behavior, *Review

Included in this chapter is a section on petroleum which covers man-generated fluxes, natural fluxes, losses during World War II, behavior of petroleum products in the marine environment, persistence of petroleum in the oceans, effects on marine organisms, and the baseline for petroleum pollution. All of the references for this brief review are dated 1972 and earlier.

C-0233-78

MARINE OIL SPILLS

Lovell, A.H. 1976.
Waste Disposal & Water Management in Australia 3(4):12-13,15-16.

Oil spills, Spill damage, Spill disposal

Summary not available.

[from Australian Science Index 20(11): #4362. 1976.]

C-0234-78
ARGO MERCHANT: A SCIENTIFIC COMMUNITY'S RESPONSE
Milliman, J.D. 1977.
Oceanus 20(4):40-45.

Argo Merchant spill, Fate, Environmental effects, Sampling, *Woods Hole Oceanographic Institution

Woods Hole Oceanographic Institution scientists responded to the Argo Merchant grounding by immediately collecting background information about the water and sediments in the vicinity of the wreck. The sampling and monitoring cruises are discussed, and research needs for baseline studies and for data on the fate of oil are stated. Weather prevented optimum sampling, but a group of background samples crucial to spill impact studies were collected during two cruises.

C-0235-78
THE CONTROL OF OIL POLLUTION ON THE SEA AND INLAND WATERS (book review)
MORRIS, R. J. 1977.
Estuarine and Coastal Marine Science 5(6):829-830.

Environmental effects, Oil spills, Spill cleanup, Surfactants, Chronic effects

The title book [J. Wardley-Smith (ed.). London, Graham & Trotman Ltd., 1976. 251 p.] is critically reviewed. The reviewer points out weaknesses in the book, a major one being that the editor makes statements without creditable scientific basis. Useful chapters dealing with oil cleanup are cited. The reviewer points out that accidental spillage accounts for very little of total oil pollution.

C-0236-78
THE EFFECT OF POLLUTANTS ON AQUATIC ORGANISMS (book review)
Morris, R.J. 1977.
Estuarine and Coastal Marine Science 5(6):831-832.

Marine organisms, Hydrocarbons, Biological effects

The title book [A.P.M. Lockwood (ed.). New York, Cambridge University Press, 1976. 193 p.] is favorably reviewed. The book contains three chapters dealing with petroleum hydrocarbons. The reviewer reiterates the position taken by the authors of the need for more basic research in the field of hydrocarbon pollution.

C-0237-78
WATER POLLUTION — CAUSES AND CURES
Morton, S.D. 1976.
Madison, Wisconsin, Mimir Publishers Inc., 1976. 151 p.

Oil spills, Toxicity, Biodegradation, Spill cleanup, *Industrial pollutants

Pollution of the aquatic environment from domestic, municipal, industrial, and agricultural sources is reviewed, and methods for treatment are discussed. In the chapter on industrial pollution, the problems of oil spills, their toxicity, biodegradation, and methods of removal are briefly outlined.

C-0238-78
OIL AND THE ENVIRONMENT
Pearce, A.W. 1976.
Energy and the Environment, Section 2 of Man and His Environment. J. Walker (ed.). Birmingham, England, University of Birmingham, 1976. p. 147-163. Proceedings. International Symposium on Man and His Environment, University of Birmingham, September 1975.

Environmental effects, *Review

"A review with no references."

[from Chemical Abstracts 87(16): #120068w. 1977.]

C-0239-78
THE POLLUTION OF THE MEDITERRANEAN
Ritchie-Calder, L. 1975.
The Tides of Change. Peace, Pollution, and Potential of the Oceans. E.M. Borgese and D. Krieger (eds.). New York, Mason/Charter, 1975. p. 144-165.

Environmental deterioration, Contamination, Mediterranean Sea

The author gives a general geographic/geologic description of the Mediterranean Sea and considers man's detrimental impact upon it. Various pollutants including oil are reviewed.

C-0240-78
EFFECTS OF PETROLEUM ON ECOSYSTEMS
Sanborn, H.R. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 337-357.

Biological effects, Marine organisms, Habitat, Ecosystems, Arctic, Subarctic regions, Intertidal zone

Discussed in this chapter is the literature dealing with the effects of petroleum on arctic and subarctic habitats (intertidal zone and subtidal zone), populations and communities (plankton, neuston, nekton, benthos, and salt marsh), and ecosystems.

C-0241-78
DAMAGE ASSESSMENT STUDIES FOLLOWING ALEXANDRIA BAY OIL SPILL: FALL 1976 FIELD SURVEY OF RESIDUAL CONTAMINANTS
St. Lawrence-Eastern Ontario Commission. 1977.
Interim report, Grant No. R80531010. 22 p.

Oil spills, Environmental effects, Residual oils, Economic effects, Canada, *Alexandria Bay spill

On June 23, 1976, an estimated 1,166,000 L (308,000 gal) of No. 6 bunker oil were released from a barge after several tanks ruptured as it struck Comfort Shoal upstream of Alexandria Bay. Efforts were undertaken to develop a plan of study to determine the economic and environmental impacts of oil in a riverine environment. The main objective of this study was to determine the effects of time and the elements on residual hydrocarbons. Results of the fall 1976 field survey are summarized.

D. ASPECTS OF OIL EXPLORATION AND PRODUCTION

1. BIOLOGICAL ASPECTS

C-0242-78
BIRDS AND MARINE MAMMALS — THE BEAUFORT SEA AND THE SEARCH FOR OIL
Blood, D.A. 1977.
Beaufort Sea Project Overview Reports. B.D. Smiley (ed.). 124 p.

Offshore exploration, Biological effects, Birds, Marine mammals, Beaufort Sea, Arctic

This book provides the reader with up-to-date information on birds and marine mammals of the southern Beaufort Sea and how they might be influenced by offshore petroleum exploration which is currently underway. A digest is also presented of relevant Beaufort Sea Project technical reports. The Beaufort Sea Project, a set of Arctic marine environmental studies, was conducted during 1974 and 1975 in order to assess the possible impact of offshore exploratory drilling in the Beaufort Sea.

[from Beaufort Sea Project Office, Institute of Ocean Sciences, P.O. Box 5000, 9860 West Saanich Road, Sidney, B.C. Y8L 4B2, Canada]

C-0243-78
POTENTIAL EFFECTS OF OIL DRILLING AND DUMPING ACTIVITIES ON MARINE BIOTA
George, R.Y. 1975
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 333-355. Proceedings.

Offshore drilling, Biological effects, Marine organisms, Oil spills, *Drilling mud components

Gaps in the present knowledge of the impact of drilling mud components on marine biota and the chronic effects of oil spills on both marine plants and animals are explored. Four aspects of offshore drilling activity are examined for their effects on marine ecosystems: (1) the 'burial effect' on sea floor organisms caused by discharge of drilling mud components; (2) possible accumulation or magnification in the food chain of discharged drilling mud components; (3) influence of turbidity-plumes of drilling mud on filter feeding organisms; and (4) the acute and chronic effects of crude oil spillage on marine organisms.

C-0244-78
CHEMICAL STUDIES OF OFFSHORE OIL PLATFORMS
McDermott-Ehrlich, D., and G.A. Alexander. 1976.
Southern California Coastal Water Research Project, Annual Report, 129 p.

Biological effects, Drilling, Offshore production, Platforms, Marine organisms, Sediments, Santa Barbara Channel

A study was conducted to determine the effects of drilling and oil production operations on the marine life around two oil platforms, "Hazel" and "Hilda," in the Santa Barbara Channel. Hydrocarbon content of tissue samples of two species of rockfish, the yellow rock crab, and an intertidal mussel were determined by gas chromatography and revealed no detectable hydrocarbons in the crabs or mussels, but very high levels of biogenic hydrocarbons in the rockfish. The petroleum hydrocarbon content of sediment samples under the platforms were higher than levels measured at a control site but were indicative of highly weathered oil and not recent contamination.

C-0245-78
EFFECT OF DRILLING FLUID COMPONENTS MIXTURES ON PLANTS AND SOILS
Miller, R.W., and S. Honarvar. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 125-143. Proceedings.

Drilling, Toxicity, Plants, *Growth, *Drilling fluid components

Thirty-one oil well drilling fluid components were tested at normal use concentrations for their effects on plant growth. Significant (5%) reductions in yield occurred with diesel oil, large alcohol, guar gum, a plant synthetic fiber mix (Kwik Seal), lignite, potassium chloride, pregelatinized starch, a modified asphalt (Soltex), and iron-chromelignosulfonate. Of the components tested, only diesel oil is believed to cause severe problems to plant growth.

C-0246-78
ACUTE TOXICITY OF WELL-DRILLING MUDS TO RAINBOW TROUT SALMO GAIRDNERI (RICHARDSON)
Weir, R.H., and B. Moore. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 169-182. Proceedings.

Toxicity, Drilling, Fish, Mortality, Arctic, *Salmo gairdneri, *Drilling muds

The acute toxicity of oil well drilling muds to rainbow trout was tested under 96-hour static bioassay test conditions. Mud samples were taken at various well depths from an onshore Canadian Arctic exploratory well, and tested at various concentrations to determine 96 hr LC_{50} to the test population. The acute toxicity of the drilling muds was directly related to the type of mud system used at various depths of the well. The toxicity increased with sample depth, due to the increase in solids and viscosities of deep well mud systems.

C-0247-78
TOXICITY AND ENVIRONMENTAL PROPERTIES OF CHEMICALS USED IN WELL-DRILLING OPERATIONS
Zitko, V. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 311-329. Proceedings.

Drilling, Oil wells, Toxicity, Environmental effects, Fish, *Salmon, *Drilling muds

The acute toxicities of several organic oil well drilling mud components to juvenile Atlantic salmon were tested. Benzoic acid, benzene derivatives, naphthalene, substituted imidazolines and Na petroleum sulfonates were tested and found to have less pronounced environmental effects than the physical action of suspended solids.

2. ECONOMIC ASPECTS

C-0248-78
ENVIRONMENTAL EXPENDITURES OF THE UNITED STATES PETROLEUM INDUSTRY 1967-1976
Haskins & Sells. 1977.
Washington, D.C. American Petroleum Institute Publications No. 4287. 14 p.

Cost analysis, Economics, Oil industry, API, Refineries, Pollution control, *Environmental expenditures

The title expenditures, as reported to API via a survey of its member companies and members of the National Petroleum Refiners Association, are tabulated. A sample questionnaire as submitted to these companies is appended to the report.

C-0249-78
TEXAS SHRIMPERS WORRIED ABOUT SALT DOME PLANS (news brief)
Kirkpatrick, K., and D. Kirkpatrick. 1977.
National Fisherman 58(6):31-A, 35-A.

Storage, Offshore development, FEA, Environmental effects, Fisheries, Mexico/Gulf of, *Shrimp, *Salt domes

The Freeport Shrimpers Association (FSA) in Texas is opposed to the way the Federal Energy Administration (FEA) plans to wash out nearby salt domes with Gulf water for future oil storage. Pumping a saline solution that may be 99% salt into the Gulf may produce a barren area in one of the prime white shrimp breeding grounds. The 371 km (200 mi) limit which will bring in more fishing boats and more oil development is another major problem.

3. GENERAL ASPECTS

C-0250-78
INTERIOR REVISES OCEAN DRILLING GUIDELINES (news brief)
Anon. 1977.
Chemical & Engineering News 55(41):23.

Offshore development, Oil-gas leasing, Regulations, US Government, Environmental protection, State governments

The US Department of Interior has announced substantial revisions in leasing policies and regulations. The revised regulations will call for more detailed technical and environmental data and will provide greater input from the states affected by the offshore oil-gas development.

C-0251-78
VIRGINIA OIL REFINERY OK NEARS REALITY (news brief)
Anon. 1977.
National Fisherman 58(7):24-D.

Refineries, Environmental effects, EIS, Virginia, Chesapeake Bay, *Oyster beds

The Virginia Oyster Growers and Packers Association is opposing the planned oil refinery at Portsmouth, VA. There seems to be a legal question as to whether the group can act before actually being "aggrieved," or must wait for a future oil spill to damage the James River seed oyster beds — the major source of seed for all the Virginia portion of Chesapeake Bay and an occasional supplier to Maryland and other states. Details are given of an environmental impact statement reporting on the numerous detrimental effects that are hazards of this project.

C-0252-78
OFFSHORE OIL: COSTS AND BENEFITS
Bradley, T. 1976.
Washington, D.C., American Enterprise Institute for Public Policy Research, 1976. 49 p.

Offshore development, Environmental effects, Onshore impacts, Regulations, Oil-gas leasing, Economics

This pamphlet contains the edited transcript of a Round Table that concluded American Enterprise Institute's conference on the impact of offshore oil, held at Los Angeles, in March, 1975. Regulations regarding the leasing of offshore sites and the impact of energy conservation on energy supplies are summarized.

[from Energy Review 21:24. 1977.]

C-0253-78
A STUDY PLAN FOR THE ALASKAN CONTINENTAL SHELF
Bruce, H.E. 1976.
Assessment of the Arctic Marine Environment: Selected Topics. D.W. Hood and D.C Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 61-80. (Occasional Publication No. 4).

Offshore development, Environmental effects, OCS, Baseline studies, Monitoring, NOAA, BLM, Alaska

The objectives of the NOAA and BLM Alaskan OCS studies are to develop a data base on the biological, physical, chemical, and geological processes of the area to be used in assessment and prediction of the impact of oil and gas developments on the marine environment and resources of the region. Guidelines, objectives, program structure, budget, and management are discussed.

C-0254-78
THE NORTH SEA PROBLEM
Bugge, H.C. 1976.
Assessment of the Arctic Marine Environment: Selected Topics. Hood, D.W. and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 45-54. (Occasional Publication No. 4).

Offshore development, Environmental effects, Pollution control, North Sea, Norway

This paper briefly reviews Norway's offshore petroleum exploration in the North Sea, impact assessment, and pollution control. At the time this report was published, no major oil spills had occurred there.

C-0255-78

USE OF A BIOASSAY TEST IN EVALUATING THE TOXICITY OF DRILLING FLUID ADDITIVES ON GALVESTON BAY SHRIMP

Chesser, B.G., and W.H. McKenzie. 1975.
Conference on Environmental Aspects of Chemical Use in Well Drilling Operations, Houston, 1975. p. 153-168. Proceedings.

Toxicity, Drilling, Marine organisms, Shrimp, *Drilling fluid additives

Results of 96-hour salt water toxicity tests with several common drilling fluid additives are given. The materials tested include hemlock bark extract, chrome-treated lignosulfonate, iron lignosulfonate, non-water dispersible defoamer, low-molecular weight polyacrylate, and cellulosic-calcium carbonate workover additive. The 50% toxicity level of brown or white shrimp is given for each additive.

C-0256-78

EFFECTS OF OIL SPILLS IN ARCTIC AND SUBARCTIC ENVIRONMENTS

Clark, R.C., Jr., and J.S. Finley. 1977.
Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. D.C. Malins (ed.). New York, Academic Press, 1977. Vol. II, Biological Effects. p. 411-476.

Environmental effects, Biological effects, Oil spills, Arctic, Subarctic regions

Results are outlined which give evidence for understanding the potential for damage to arctic and subarctic ecosystems from petroleum. Information is based on data relating to temperate waters and species, since little or no information on cold water environments was available. Topics covered include: definition of arctic and subarctic marine environments, problems in predicting the biological impacts of oil spills, arctic and subarctic oil spills and their long-term biological effects, and Pacific subarctic and Arctic Ocean as potential oil spill areas.

C-0257-78

POSSIBLE CONTAMINATION OF GROUND WATERS BY OIL AND GAS-WELL DRILLING AND COMPLETION FLUIDS

Collins, A.G. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 231-256. Proceedings.

Contamination, Groundwater, Drilling, Oil wells, *Drilling fluids, *Well completion

Chemicals used in the drilling fluids and in well completion and treatment are listed; several of them are quite capable of polluting water and land. The compositions of some oilfield brines and crude oils which can be used to prepare drilling fluids are listed. Possible ways in which drilling fluids and well operations may contaminate groundwater are outlined, and methods for rehabilitating a contaminated aquifer are discussed.

C-0258-78
BIG GAINS IN GEORGES BANK FISHERIES WEIGHED AGAINST PROJECTED OIL FINDS (news brief)
Duerr, C. 1977.
National Fisherman 58(5):14-B.

Offshore exploration, Offshore development, Oil industry, Fisheries, Economic effects, Georges Bank

A two-year University of Rhode Island study has been done of the potential conflicts between the fishing industry and the offshore oil industry when oil exploration begins on Georges Bank. It is estimated that the New England ground-fisheries will experience large growth as a result of the Fisheries Management and Conservation Act of 1976, with a possible doubling of permanent employment offered. At the maximum petroleum development, oil reserves from the bank could supply only 17% of the region's total petroleum needs; while gas reserves could supply over 200% of the region's needs. At maximum development, 201 km (125 mi) could be closed to fishing with towed gear; thus, close consultation on the placement of offshore structures is necessary. Very little is known about the potential environmental effects of oil development in this area.

C-0259-78
PRODUCTION AND PROCESSING OF US TAR SANDS: AN ENVIRONMENTAL ASSESSMENT
Frazier, N.A., D.W. Hissong, W.E. Ballantyne, and E.J. Nazey. 1976.
Final Report, EPA-600/7-76-035, Contract EPA-68-02-1323. 92 p.

Tar sands, Production, Extraction, Environmental effects

Preliminary study results are reported which assess the potential primary environmental impacts of production and processing of tar sands bitumen. Impacts of mining methods are likened to those of strip-mining coal; and impacts of in situ methods are judged to be similar to those of conventional oil field production. A viable in situ production technology for producing tar sand reservoirs is not available, but it is still questioned whether in situ methods can provide an alternative to surface mining.

[from Scientific and Technical Aerospace Reports 15(19): #N77-28575. 1977.]

C-0260-78
ONSHORE PLANNING FOR OFFSHORE OIL — LESSONS FROM SCOTLAND (book review)
Hammond, R.E. 1976.
Coastal Zone Management Journal 2(2):189.

Offshore development, Onshore impacts, US, Scotland, *Planning

The title book [P.L. Baldwin and M.F. Baldwin. Washington, D.C., The Conservation Foundation, 1975.] "offers both a basic analytical framework applicable to offshore-oil-related planning issues, and a perceptive critique of the approach to offshore oil development that presently prevails in the United States." The authors warn that planning should be specific to each case, but draw anologies between Scotland and US offshore oil development with emphasis on minimal environmental, social, and economic disruption. It appears that oil pollution concerns are only briefly mentioned.

C-0261-78
MARINE TERMINUS OF THE TRANS-ALASKA PIPELINE
Hood, D.W. 1976.
Assessment of the Arctic Marine Environment: Selected Topics. D.W. Hood and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 95-117. (Occasional Publication No. 4.).

Environmental effects, Ballast, Wastewaters, Pipelines, Oil spills, Marine organisms, Alaska, *Port Valdez

A review is presented of the environmental susceptibility of Port Valdez. Topics covered include the effects of ballast water, effluents and oil spills on the marine biota.

C-0262-78
ASSESSMENT OF THE ARCTIC MARINE ENVIRONMENT: SELECTED TOPICS
Hood, D.W., and D.C. Burrell (eds.). 1976.
Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. xi + 468 p. (Occasional Publication No. 4.)

Offshore development, Environmental effects, Arctic

This book is based on topics selected from a symposium held in August 1975 in Fairbanks, Alaska in conjunction with the Third International Conference on Port and Ocean Engineering under Arctic Conditions. Resource extraction, technology and engineering problems, phytoplankton importance, and the environmental effects of man's activities are included, and four chapters comprise the section "Hydrocarbons in the Arctic Environment."

C-0263-78
ENVIRONMENTAL EFFECTS OF OFFSHORE OIL PRODUCTION: ALKANES IN THE REGION OF THE BUCCANEER OILFIELD
Middleditch, B.S., B. Basile, and E.S. Chang. 1977.
Journal of Chromatography Vol. 142:777-785.

Hydrocarbons, Sources, Marine organisms, Offshore production, Environmental effects, Chromatography

"n-Alkanes, pristane, and phytane are among the hydrocabons in discharged brine from production platforms in the Buccaneer oilfield. These compounds are detected in surface seawater samples, but hydrocarbons in bottom water samples are apparently of bacterial origin. Petroleum alkanes are also found in shrimp, fish, barnacles, plankton, and sediments."

C-0264-78
CANADIAN ENVIRONMENTAL STUDIES OF THE SOUTHERN BEAUFORT SEA
Milne, A.R. 1976.
Assessment of the Arctic Marine Environment: Selected Topics.
D.W. Hood, and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science, 1976. p. 87-94.
(Occasional Publication No. 4.).

Offshore exploration, Baseline studies, Environmental effects, Ice, Beaufort Sea, Canada

The Beaufort Sea Project is a set of environmental studies upon which are based recommendations for the allocation of a drilling authority to the marine drilling companies interested in oil exploration in these Canadian waters. This paper reviews the program objectives for the scope of the project and baseline studies. Included under project activities is a description of the research craft, the biological surveys, physical studies, ice climatology, and oil in ice.

C-0265-78
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF.
VOLUME 3. PRINCIPAL INVESTIGATOR'S REPORTS JULY — SEPTEMBER 1976
National Oceanic and Atmospheric Administration. 1976.
Quarterly Report, NOAA-77011701. 968 p.

Offshore development, Environmental effects, Baseline studies, OCS, Biological effects, Alaska

Baseline studies are presented on the environmental effects of resources development on the outer continental shelf of Alaska. Included are biological effects on various aquatic communities and baseline studies of the physical oceanography of the area.

[from Government Reports Announcements 77(19): #PB-269 955/1GA. 1977.]

C-0266-78
OIL IN THE ARCTIC: 1. HISTORICAL, ENVIRONMENTAL AND REGIONAL PERSPECTIVES
Norton, D.W. 1977.
Interdisciplinary Science Reviews 2(3):207-214.

Environmental deterioration, Conservation, Oil industry, Pipelines, Offshore development, Alaska

An ecologist's viewpoint of the historical, environmental and political background to the Alaska oil pipeline and offshore development is presented. The disruptive and adverse effects of oil industry expansion and pipeline construction on Alaska's conservation and environmental protection policies are detailed.

C-0267-78
ENVIRONMENTAL IMPACTS FROM OFFSHORE EXPLORATION AND PRODUCTION OF OIL AND GAS
Organization for Economic Co-operation and Development (Paris). 1977.
Environment Directorate 32090. 95 p.

Offshore exploration, Offshore production, Environmental effects, Oil spills, Legislation, Onshore impacts

Environmental impacts of offshore development are described, including trends for OECD countries in terms of likely petroleum reserves and potential pollution effects. Five subject areas are covered in detail: (1) large accidental spills from offshore platforms and pipelines; (2) chronic pollution from offshore activities; (3) legislation concerning offshore construction; (4) probability of occurrence of oil spills; and (5) onshore effects.

[from Selected Water Resources Abstracts 15(19): #W77-09258. 1977.]

C-0268-78
ENVIRONMENTAL EFFECTS OF DRILLING MUDS AND CUTTINGS
Ray, J.R., and E.A. Shinn. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 533-545. Proceedings.

Offshore drilling, Environmental effects, Platforms, Marine organisms, *Drilling discharges

A Shell research group studied some of the environmental parameters concerning offshore drilling discharges from an offshore Louisiana drilling site. Drilling discharges were found to be rapidly dispersed and diluted in the water column to below toxic levels. There appeared to be no visible detrimental effects of drilling discharges to organisms living above the bottom, and cutting piles beneath other platforms were repopulated with marine organisms.

C-0269-78
AN EVALUATION OF LOUISIANA SUPERPORT STUDIES AND IMPLICATIONS FOR COASTAL ZONE MANAGEMENT
Stone, J.H. 1976.
Coastal Zone Management Journal 3(1):7-37.

Ports, Economic effects, Environmental effects, Offshore development, Onshore impacts, Louisiana, *Superport

Studies during the last 3 years on the economic and environmental effects of a proposed Louisiana superport have provided technical information and management alternatives. Discussed are state control to avoid multiple superport developments, details for an Environmental Protection Plan, onshore and offshore site comparisons, and plans for auxiliary development. Various analytical methods for use in coastal zone management are assessed.

[from International Aerospace Abstracts 17(20): #A77-43697. 1977.]

C-0270-78
PROCEEDINGS OF A WORKSHOP ON ENVIRONMENTAL OCEANOGRAPHY OF THE GULF OF MEXICO
Texas A&M University. 1976.
ORO-5017-1, Conf-760363· Contract E(40-1)-5017. 55 p. Workshop held at College Station, Texas, 15-16 March 1976.

Offshore development, Oil industry, Environmental effects, Mexico/Gulf of

At this workshop, the most critical energy-related environmental problems in the Gulf of Mexico were discussed and the framework for a program of research to solve these problems was developed. A major concern is activity related to the oil and gas industry: production, transportation, processing, and use of petroleum derived funds.

[from Scientific and Technical Aerospace Reports 15(17): #N77-26787. 1977.]

C-0271-78
OILSPILL RISK ANALYSIS FOR THE MID-ATLANTIC OUTER CONTINENTAL SHELF LEASE AREA
US Geological Survey. 1976.
Reston, Virginia, US Geological Survey, 1976. 26 p.

Offshore development, Environmental effects, Oil spills, OCS, Atlantic Coast, *Risk analysis

The analysis covers spill probability, likely paths of pollutants from spills, and locations in space and time of recreational and biological resources apt to be vulnerable. The impacts are combined to produce estimates of the overall oilspill risk associated with offshore development.

[from ERDA Energy Research Abstracts 2(16): #39243. 1977.]

C-0272-78
OILSPILL RISK ANALYSIS FOR THE SOUTH ATLANTIC OUTER CONTINENTAL SHELF LEASE AREA
US Geological Survey. 1976.
Reston, Virginia, US Geological Survey, 1976. 57 p.

Offshore development, Environmental effects, Oil spills, OCS, Atlantic Ocean, *Risk analysis

The analysis covers spill probability, likely paths of pollutants from spills, and locations in space and time of recreational and biological resources apt to be vulnerable. "Worst-case" conditions are paid particular attention. The impacts are combined to produce estimates of the overall oil-spill risk associated with offshore development.

[from ERDA Energy Research Abstracts 2(16): #39244. 1977.]

C-0273-78
OIL IN THE ARCTIC: 2. THE OUTER CONTINENTAL SHELF ASSESSMENT PROGRAM
Weller, G., and D.W. Norton. 1977.
Interdisciplinary Science Reviews 2(3):215-226.

Biological effects, Offshore development, Animals, Plants, Marine organisms, OCS, Arctic, Ice, Environmental effects

Projects being conducted north of Bering Strait, as part of the U.S. Outer Continental Shelf Environmental Assessment Program, are examined to see what they will contribute to an understanding of environmental impacts of offshore petroleum development. One group of projects covers hazards to arctic marine mammals, seabirds, fish, benthos, littoral biota, and plankton and to the sea ice habitat. Other projects will provide chemical and oceanographic baseline data, such as water movement and ice dynamics. In addition, the biological impact of oil in the Arctic, and hazards of Arctic conditions on offshore oil exploration and production are assessed.

C-0274-78
EFFECTS OF DRILLING OPERATIONS ON THE MARINE ENVIRONMENT
Zingula, R.P. 1975.
Environmental Aspects of Chemical Use in Well-Drilling Operations, Houston, 1975. p. 433-488. Proceedings.

Environmental effects, Biological effects, Offshore drilling, Marine organisms

Exxon scientists studied the effects of offshore drilling operations on the marine environment. Suspended drilling solids were found to decrease very rapidly in a short distance from the drilling rig, mobile organisms were active on and around borehole cutting accumulations, and the cuttings were found to turn into "normal" sea bottom in several months. Chemicals normally used in drilling were found to interact with and become diluted in sea water. No adverse effects are reported.

E. FATE OF OIL IN THE ENVIRONMENT

1. BIODEGRADATION

C-0275-78
ROLE OF PHYTOPLANKTON AND BACTERIOPLANKTON IN THE BIOLOGICAL DECOMPOSITION OF SHALE TAR [in Russian]
Bogogosyan, A.T. 1975.
Materialy Vsesoyuznogo Simpoziuma po Sovremennym Problemam Samoochishcheniya i Regulirovaniya Kachestva Vody, 5th. (Materials of the All-Union Symposium on Current Problems of Self-Purification and Regulation of Water Quality.) Vel'ner, Kh.A., et al. (eds.). Tallinn, USSR, Tallinskii Politekhnicheskii Institut, 1975. Vol. 3:3-8.

Biodegradation, Oil shale, Tar, Plankton, Algae, Bacteria

"Of 15 algae species, Chlorella vulgaris was the most resistant to shale tar; it showed intensive photosynthesis in the presence of shale tar and the necessary biogenic elements. Decomposition of shale tar occurred at a high rate in the presence of a complex mixture of algae and bacteria."

[from Chemical Abstracts 87(19): #148437q. 1977.]

C-0276-78
QUANTITATIVE STUDIES ON MARINE BIODEGRADATION OF OIL, III. COMPARISON OF DIFFERENT CRUDE OIL RESIDUES AND EFFECTS OF SEA WATER SOURCE
Davis, S.J., C.F. Gibbs, and K.B. Pugh. 1977.
Environmental Pollution 13(3):203-216.

Biodegradation, Crude oil, Seawater, *Nutrients, *Respirometric method

A respirometric method was used to study the degradation of North Sea and Libyan crude oil residues and results were compared with previous work. The differences found seemed to be due to microbial adaptation to the nutrient regimes of winter sea water contrasted with summer sea water, rather than to the type of oil. The supply of available nitrogen appeared to be the limiting factor at any temperature, and approximately half of each crude oil residue appeared almost undegradable. The relative density of the North Sea oil residue did not exceed that of seawater; further studies are needed to determine whether it will eventually sink through weathering.

C-0277-78
POLLUTION OF SOIL
de Haan, F.A.M., and P.J. Zwerman. 1976.
Soil Chemistry: A. Basic Elements. G.H. Bolt, and M.G.M. Bruggenwert (eds.). Amsterdam, Elsevier Science Publishers, 1976. p. 192-271.

Biodegradation, Oil spills, Soil, Disposal, Sludge, *Aeration, *Nutrient addition

The pollution of soil by various contaminants is reviewed, with emphasis on their persistence, interactions with soil, and biodegradation. Included is a brief section on oil from spills and oil sludge disposal. Biodegradation of oil in soil is aided by aerobic conditions, by thorough mixing with the soil, and by addition of nutrients containing phosphorus and nitrogen.

C-0278-78
ECOLOGICAL STUDIES ON HYDROCARBON-OXIDIZING BACTERIA IN JAPANESE COASTAL WATERS — I. SOME METHODS OF ENUMERATION OF HYDROCARBON-OXIDIZING BACTERIA
Fujisawa, H., M. Murakami, and T. Manabe. 1977.
Bulletin of the Japanese Society of Scientific Fisheries 43(6): 659-668.

Biodegradation, Hydrocarbons, Oxidation, Bacteria, Coasts, Japan, *Enumeration methods

L-alanine and ammonium chloride are recommended as suitable organic and inorganic nitrogen sources for hydrocarbon oxidizers in Japanese coastal waters. Numbers of oxidizers in samples were determined by the minimum dilution technique, and the accuracy of the numbers was determined by the most probable number method. Emulsification of the fluids incubated in the media and a decrease in pH value were recognized as supplementary criteria for indicating the existence of hydrocarbon oxidizers in sea water and bottom sediment inocula.

C-0279-78
ISOLATION OF TRICHODERMA HARZIANUM (RIFAI) GROWING ON FERRIC HYDROXIDE MUD IMPREGNATED WITH GAS OIL
Gudin, C., and K.W.A. Chater. 1977.
Environmental Pollution 14(1):1-4.

Biodegradation, Petroleum products, Hydrocarbons, Fungi, **Trichoderma harzianum*, *Ferric hydroxide mud

Ferric hydroxide mud, impregnated with gas oil, was found to support the growth of a fungus. The organism, *Trichoderma harzianum* Rifai, survived because of its biodegradation of the gas oil. The implications are that hydrocarbons may be deleted from an environment by microbial activity.

C-0280-78
EFFECTS OF LEAD ON BIODEGRADATION OF HYDROCARBONS IN SOIL
Jensen, V. 1977.
Oikos 28(2-3):220-224.

Biodegradation, Waste oil disposal, Soil, Refineries, *Soil cultivation process, *Lead

The effects of lead on biodegradation of oily refinery wastes in soil were studied in model experiments of the soil cultivation process of disposal of such wastes. A general reduction of bacterial populations and proliferation of a few fungal species resulted from the addition of lead. While simple alkanes continued to be readily decomposed, the decomposition of heavy fuel oil was significantly retarded.

C-0281-78
OXIDATION OF PETROLEUM HYDROCARBONS BY SEA BACTERIA [in Russian]
Tsyban, A.V., A.N. Zubakina, S.P. Barinova, and I.M. Mikhaleva. 1977.
Gidrobiologicheskii Zhurnal 13(2):39-44.

Biodegradation, Hydrocarbons, Bacteria, Seawater, USSR, *N-alkanes

Two different hydrocarbon-oxidizing bacterial cultures isolated from the Caspian Sea and the Lena Estuary were studied. Both cultures assimilated n-alkanes better than other hydrocarbons, but Caspian Sea bacteria preferentially assimilated C_{10}-C_{14} n-alkanes and Lena Estuary cultures preferentially assimilated the C_{16}-C_{24} n-alkanes.

[from Chemical Abstracts 87(14): #106591e. 1977.]

2. PHYSICAL CHANGES

C-0282-78
A METHOD FOR STUDYING THE SPREAD OF CONTAMINANTS IN THE OCEAN [in Russian]
Eremeev, V.N., N.A. Zharov, V.A. Makarevich, and V.N. Markelov. 1976.
Morskie Gidrofizicheskie Issledovaniia, No. 3:94-105.

Models, Spreading, Contaminants, Oceans

The transport of contaminants (e.g., oil, heavy metals, and radioactive isotopes) in the ocean is studied with a finite-difference type model. The model was developed with consideration of the effect of large-scale oceanic dynamic processes on the spread of the pollutant. Numerical results agree well with experimental surveys.

[from International Aerospace Abstracts 17(19): #A77-40801. 1977.]

C-0283-78
AN EXPLANATION OF THE OIL SPILL FLOW FROM MIZUSHIMA IN DECEMBER 1974 [English summary]
Konaga, S., and K. Nishiyama. 1976.
Umi to Sora, 51(2):71-77.

Oil spills, Movement, Models, *Wind drift, *Gravity current

Wind drift and gravity current are given as explanation of the rather rapid flow of an oil spill eastward from Mizushima. "Observations and calculations may agree well by placing the drag coefficient of the air sea interface, 1.2×10^{-3}, internal friction coefficient, 2.5×10^{-3}, and bottom friction coefficient, 4.0×10^{-3}, in a simple model, which is a narrow, long channel and homogenous depth of 50 m."

C-0284-78
DRIFT VELOCITIES OF SURFACE FILMS OVER WAVES
Mohr, M.C. 1977.
Masters Thesis. 95 p. PB-267661.

Oil slicks, Drift, Oceans, Pollution control, *Drift velocity, *Wind, *Waves

The convection of a surface film under the action of wind- and mechanically-generated waves was studied in a laboratory wind-wave channel by using polyethylene sheets. The drift velocity over wind-waves is a function of wind velocity and wave steepness. However, the ratio of drift velocity to the shear velocity of the turbulent air boundary layer was found to correlate uniquely with the wave steepness. In a wave field characterized by wave steepness, the effect of the wind on the drift velocity of surface films predominates over that due to waves.

[from Selected Water Resources Abstracts 10(16): #W77-08193. 1977.]

C-0285-78
FINE-GRAINED SEDIMENT AND INDUSTRIAL WASTE DISTRIBUTION AND DISPERSAL IN NEW BEDFORD HARBOR AND WESTERN BUZZARDS BAY, MASSACHUSETTS
Summerhayes, C.P., J.P. Ellis, P. Stoffers, S.R. Briggs, and M.G. Fitzgerald. 1977.
Technical Report WHOI-76-115, NOAA-77060807, Grants NOAA-04-6-158-44016, NOAA-04-6-158-44106. 121 p.

Movement, Sedimentation, Harbors, Industries, Massachusetts, *New Bedford Harbor

This report culminates a 2-year study of the patterns of movement and accumulation of fine-grained sediment, human waste, and industrial wastes in New Bedford Harbor and its approaches. Large amounts of heavy metals, oil, and grease are found in the bottom sediments of the inner harbor and the navigation channel.

[from Government Reports Announcements 77(19): #PB-269 628/4GA. 1977.]

C-0286-78
MODELING OF OIL EVAPORATION IN AQUEOUS ENVIRONMENT
Yang, W.C., and H. Wang. 1977.
Water Research 11(10):879-887.

Oil spills, Weathering, Evaporation, Models

Research developed a numerical model to predict changes in the properties of oil spilled into water. No. 2 fuel oil, Nigerian crude, and Venezuelan crude were used to determine evaporation parameters of spilled oil. Temperature, wind speed, solar radiation, and the size of the spill are factors in determining the rate of evaporation.

3. CHEMICAL CHANGES

C-0287-78
FORMATION OF TOXIC PRODUCTS FROM A #2 FUEL OIL BY PHOTOOXIDATION
Larson, R.A., L.L. Hunt, and D.W. Blankenship. 1977.
Environmental Science & Technology 11(5):492-496.

Fuel oil, Oxidation, Biological effects, Toxicity, Yeast, *Photooxidation

Oxygenated compounds toxic to baker's yeast and relatively soluble in water were formed by simulated environmental UV irradiation of a No. 2 fuel oil. Toxicity reached a maximum at 24 hr and was principally due to reactive peroxides. Addition of thiacyclohexane eliminated much of the photo-induced toxicity.

[from Pollution Abstracts 8(5): #77-04256. 1977.]

C-0288-78
PHOTOOXIDATION PRODUCTS OF NO. 2 FUEL OIL AND THEIR BIOLOGICAL EFFECTS
Larson, R.A., L.L. Hunt, and D.W. Blankenship. 1977.
American Chemical Society Middle Atlantic Regional Meeting, 11th, 1977. Washington, D.C., American Chemical Society, 1977. n.p.

Fuel oil, Oxidation, Biological effects, Toxicity, Marine organisms, *Photooxidation

A No. 2 fuel oil, on exposure to simulated environmental irradiation, absorbed O_2 and became very toxic to aquatic organisms. There was a rapid buildup of hydroperoxides; addition of mild reducing agents to the oil destroyed them and eliminated most of the photo-induced toxicity. When irradiation was continued, other classes of toxic compounds (phenols, phenolic acids, aromatic ketones) were produced. Methods for the separation and determination of acidic oxidation products from oils are discussed.

[from Pollution Abstracts 8(5): #77-04199. 1977.]

4. GENERAL FATE OF OIL

C-0289-78
NORWEGIANS LOSE TRACK OF BLOWOUT POLLUTION (news brief)
Anon. 1977.
Sea Technology 18(10):24.

Ekofisk blowout, Drift, Crude oil, Oil slicks

The US-based Norwegian Information Service reports that all traces of the oil from the Ekofisk blowout have been lost. Authorities earlier speculated that the slick would have reached North German coastlines by late 1977. The oil was last seen in June 1977.

C-0290-78
"SLIKTRAK" — A COMPUTER SIMULATION OF OFFSHORE OIL SPILLS
Anon. 1977.
Spill Technology Newsletter 2(4):35-41.

Oil spills, Cost analysis, Fate, Models, North Sea, Ekofisk blowout, *SLIKTRAK program

The Sliktrak program was developed by Shell International Petroleum to model the behavior and fate of oil spilled on the open sea, with special emphasis on North Sea situations. The model provides a fast and realistic method for evaluating the order of magnitude of expectable pollution costs and cleanup requirements for a spill at sea. The April 1977 Ekofisk blowout confirmed the model's viability and its predictions that little if any of the oil spilled would reach North Sea shores.

C-0291-78
USGS SCIENTISTS HONORED FOR OILSPILL RISK ANALYSIS (news brief)
Anon. 1977.
Sea Technology 18(9):44.

Models, Statistical analysis, Offshore development, Oil spills, OCS, *Spill trajectory

James R. Slack, mathematician, and Dr. Richard A. Smith, hydrologist, at the USGS National Center received awards for their work in "developing programming, and using a computer model for making estimates of the risks that oilspills from potential oil development on the Outer Continental Shelf (OCS) will have on critical biological and environmental resources." Their analysis provides the most pessimistic but statistically valid forecast of oilspill risk possible.

C-0292-78
LONG-TERM TRANSPORT OF PETROLEUM HYDROCARBONS IN DELAWARE ESTUARY SEDIMENTS FOLLOWING THE "CORINTHOS" OIL SPILL OF JANUARY, 1975
Fiest, D.L., and J.F. Wehmiller. 1977.
American Chemical Society Middle Atlantic Regional Meeting, 11th, 1977. Washington, D.C., American Chemical Society, 1977. n.p.

Hydrocarbons, Fate, Sedimentation, Estuaries, Restoration, Delaware, *Corinthos oil spill

The aliphatic fraction of benzene-methanol extracts of >80 bottom sediment grab samples taken in the Delaware Estuary were characterized. "Over 12 stations between Marcus Hook, Pennsylvania, and the lightering area have been reoccupied over a 14 mo. period subsequent to the Corinthos oil spill at Marcus Hook, in January, 1975." Findings related to the sediment transport of petroleum hydrocarbons are discussed.

[from Pollution Abstracts 8(5): #77-04197. 1977.]

C-0293-78
SMALL RADIO BUOY FOLLOWS OIL SLICKS
Fingas, M. 1977.
Sea Technology 18(10):29-30.

Oil slicks, Monitoring, Drift, Design-engineering, *Tracking buoy

A small oil spill tracking buoy was designed, and produced by Orion Electronics Limited in Nova Scotia. The buoy floats at the same rate as water-borne oil, and is equipped with a transmitter device so that it may be tracked, especially in inclement weather. Trials in 1976 showed that the buoy worked in practice and further, these trials led to design improvements.

C-0294-78
SEA SURFACE CIRCULATION IN THE NORTHWEST APEX OF THE NEW YORK BIGHT — WITH APPENDIX: BOTTOM DRIFT OVER THE CONTINENTAL SHELF. VOLUME I. VOLUME II, PART 1. DIAGRAMS AND DATA FOR INTERFACE DRIFT CARDS. PART 2. DIAGRAMS AND DATA FOR SEABED DRIFTERS
Hardy, C.C., E.R. Baylor, and P. Moskowitz. 1976.
NOAA-TM-ERL-MESA-13, NOAA-77050502. 334 p. Technical memorandum.

Movement, Sea surface, Oil slicks, OCS, Oil transport, Oil discharges, New York

This preliminary study of the movement of the sea surface in the New York Bight represents an attempt to observe the movement of simulated slicks under field conditions. Field observations permit assessment of: "the relative risk of coherent slicks converging onto the shore resulting from the operation of working oil fields on the outer continental shelf, from oil tanker and pipeline commerce and ocean dumping; and the meteorological and oceanographic conditions which effect whether, where and when slicks will strand on Long Island."

[from Government Reports Announcements 77(18): #PB-269 028/7GA. 1977.]

C-0295-78
MARINE POLLUTANT TRANSFER. VOL. XII (book review)
Kraybill, H.F. 1977.
Environmental Research 14(1):182.

Hydrocarbons, Distribution, Seawater, Sediments, Marine organisms, Environmental effects

This volume [H.L. Windom, and R.A. Duce (eds.). Lexington, Massachusetts, D.C. Heath and Company, 1976. viii + 392 p.] consists of the proceedings of an interdisciplinary workshop sponsored by the National Science Foundation. The air, sea, and sediments are addressed in terms of transfer and geographic distribution of pollutants. Effects of pollutants such as hydrocarbons on marine animals and the aquatic environment are discussed.

C-0296-78
POLLUTION PROCESSES (book review)
Livingston, R.J. 1977.
Science 198(4315):392.

Hydrocarbons, Weathering, Fate, Oceans, *Pollutant transfer

The book Marine Pollutant Transfer [H.L. Windom, and R.A. Duce (eds.). Lexington, Massachusetts, D.C. Heath and Company, 1976. viii + 392 p.] is concerned with the transfer of pollutants, including heavy metals, chlorinated hydrocarbons, and petroleum hydrocarbons in the marine environment. The reviewer points out minor areas of omission in the scope of the subject, but considers the book useful to marine researchers because of its clarity of organization. Of the 15 chapters, Chapters 7-10 and 12 are directly relevant to petroleum hydrocarbons.

C-0297-78
SURVEILLANCE OF THE MARINE ENVIRONMENT FOR PETROLEUM HYDROCARBONS
McAuliffe, C.D. 1976.
Assessment of the Arctic Marine Environment: Selected Topics.
D.W. Hood and D.C. Burrell (eds.). Fairbanks, Alaska, University of Alaska, Institute of Marine Science 1976. p. 403-424. (Occasional Publication No. 4.).

Hydrocarbons, Seawater, Sediments, Weathering, Biodegradation, *Photooxidation

The natural and anthrogenic inputs of hydrocarbons in marine waters and sediments are reviewed. The natural mechanisms by which the hydrocarbons are physically destroyed through weathering, biodegradation and photooxidation are discussed.

C-0298-78
A REVIEW AND EVALUATION OF BASIC TECHNIQUES FOR PREDICTING THE BEHAVIOR OF SURFACE OIL SLICKS
Stolzenbach, K.D., O.S. Madsen, E.E. Adams, A.M. Pollack, and C.K. Cooper. 1977.
Sea Grant Program Report, MITSG-77-8, NOAA-77042906, Grant NOAA-04-6-158-44081. 326 p.

Oil slicks, Behavior, Models

The techniques reviewed enable predictions to be made which are needed to effect protective measures to minimize oil spill impacts. The following are discussed: representation and determination of wind fields; advection of oil slicks due to currents and wind-waves; physical changes in an oil slick; and review and evaluation of models for oil slick behavior. A comprehensive bibliography is included.

[from Government Reports Announcements 77(18): #PB-268 220/1GA. 1977.]

C-0299-78
STUDIES ON SEA ICE CHEMISTRY: STATE OF THE ART AND OBJECTIVES
[English summary]
Tsurikov, V.L., and A.P. Tsurikova. 1977.
Okeanologiya 17(1):55-64.

Ice, Fate, Movement, Offshore development, *Oil-in-ice

Chemical properties of sea ice and the biogenic and organic matter (including living organisms) contained in sea ice are considered. The role of ice as a carrier of pollutant oil is unknown. Further studies are deemed important in view of oil-field developments on the Northern shelves.

[from Biological Abstracts 64(8): #43971. 1977.]

C-0300-78
THE CHEDABUCTO BAY SPILL — *ARROW*, 1970
Vandermeulen, J.H. 1977.
Oceanus 20(4):31-39.

Chedabucto Bay, Fuel oil, Decomposition, Fate, *Wave energy

The tanker *Arrow* sank February 4, 1970, spilling 1.7 million L (450,000 gal) of Bunker C fuel oil into Chedabucto Bay, Nova Scotia. The natural erosion of the oil has been studied; about 75% disappeared in 2 years. Wave energy directly affects the erosion rate and the "half life" of the oil. Lagoons and estuaries have a potentially long half-life of oil, due to mild wave action. Other results of the study are that oil, in decomposing, may change chemically, thereby creating other problems.

C-0301-78
STUDIES OF PERSISTENCE OF OIL POLLUTION IN THE STRAIT OF MAGELLAN AFTER THE "METULA" SPILL
Wickramasinghe, R.H., A.L. Mills, J.D. Walker, R.R. Colwell, *et al*. 1977.
American Chemical Society Middle Atlantic Regional Meeting, 11th, 1977. Washington, D.C., American Chemical Society, 1977.
Abstract.

Metula spill, Crude oil, Fate, Hydrocarbons, Biodegradation, Magellan/Strait of

Selected sites in oil-impacted and oil-free areas in the Straits of Magellan were sampled in May, 1976. The high levels of total extractable material and of aliphatic and aromatic material in samples from the oil-impacted sites, after 2 years postspill, indicated that petroleum degradation under cold climatic conditions proceeds at a relatively slow rate.

[from Pollution Abstracts 8(5): #77-04198. 1977.]

C-0302-78
TAR 'SPECKS' IN THE NORTH ATLANTIC
Zsolnay, A. 1977.
Marine Pollution Bulletin 8(5):116-117.

Tar, Seawater, Fate, Distribution, Filtration, Atlantic Ocean

When seawater is filtered, a large number of dark specks are found on the filter and they are likely to be sunken pieces of tar, based on their high UV-absorbence. Six cruises in the North Atlantic surveyed 7 water columns and results indicate that there are considerable amounts of tar below the ocean's surface (an average of 0.12 μg/L) and that tar speck distributions are independent of hydrographic conditions.

F. OIL POLLUTION REGULATIONS

1. US LEGISLATION

C-0303-78
ECO NOTES: IN BRIEF (news brief)
Bass, D. 1977.
Environmental Action 9(10):13.

Legislation, US, California, Oil industry, *Coastal zone management

The Office of Coastal Zone Management has been restrained by U.S. District Judge Francis Whelan from adopting California's restrictive coastal zone management plan. The suit was filed by 19 oil companies and two oil industry trade associations.

C-0304-78
CONTROL OF POLLUTION BY OIL AND HAZARDOUS SUBSTANCES, DISCHARGE REMOVAL
U.S. Coast Guard. 1976.
Federal Register 41(59):12628-12634.

Oil discharges, Regulations, Spill cleanup, Pollution control, USCG

The Department of Transportation has issued rules concerning notification to the Coast Guard of the discharge of oil or hazardous substances, the removal of the discharged oil, and the costs or reimbursements that may be imposed or recovered for removal of the discharged substances. A vessel or an onshore or offshore facility will be assessed a fine for the illegal discharge of the proscribed substances.

[from Selected Water Resources Abstracts 15(18): #W77-08987. 1977.]

C-0305-78
SITE EVALUATION AND PRECONSTRUCTION TESTING AT POTENTIAL DEEPWATER PORT LOCATIONS
U.S. Coast Guard. 1976.
Federal Register 41(79):16798-16801.

Offshore development, Ports, Regulations, USCG, *Deepwater Port Act

"The procedural regulations concerning license applications under the Deepwater Port Act of 1974 have been amended to require that advance notice and site evaluation reports be furnished to the Coast Guard by any individual engaged in deepwater port site evaluation or preconstruction testing, and to establish a mechanism whereby the Commandant may regulate these activities."

[from Selected Water Resources Abstracts 15(18): #W77-08989. 1977.]

C-0306-78
OIL POLLUTION LIABILITY
U.S. Congress. 1976.
House Committee on Merchant Marine Fisheries Hearings. 94th Congress 1 & 2, Oct 29, Nov. 4, 12, 18, Dec. 2, 4, 16, 1975; Jun. 29, 1976. 373 p.

Liability, Compensation, Oil spills, International conventions, Spill cleanup, *Oil spill fund

"Hearings were held to consider H.R. 9294 and H.R. 10969, bills to provide a comprehensive system of liability and compensation for oil spill damage and removal costs and to implement the international convention on civil liability for oil pollution damage and the international convention on the establishment of an international compensation fund for oil pollution damage; and H.R. 10363 and H.R. 10756, bills to establish a uniform and comprehensive legal regime governing liability and compensation for damage and cleanup costs caused by oil pollution of the marine environment."

[from Environment Abstracts 7(7/8): #77-03914. 1977.]

2. INTERNATIONAL LEGISLATION

C-0307-78
A MEDITERRANEAN COUNCIL TO COMBAT POLLUTION
Borgese, E.M. 1975.
The Tides of Change. Peace, Pollution, and Potential of the Oceans. E.M. Borgese and D. Krieger (eds.). New York, Mason/Charter, 1975. p. 211-219.

International agreements, Legislation, Pollution control, Mediterranean Sea, *UN Conference/Law of the Sea

The model draft agreement for the Mediterranean Council to Combat Pollution given at the 1974-75 United Nations Conference on the Law of the Sea is presented.

C-0308-78
THE UNITED NATIONS ENVIRONMENT PROGRAM: THE MEDITERRANEAN CONFERENCES
DeHoyos, D. 1976.
Harvard International Law Journal 17:639-649.

International conventions, Pollution control, Monitoring, Economics, Mediterranean Sea, *UNEP

The Untied Nations Environment Program (UNEP) sponsored regional conferences in 1975 and 1976 in which the states bordering the Mediterranean drafted and adopted an Action Plan, a Convention, and two Protocols to deal with pollution control in the Mediterranean Sea. As part of the Action Plan, a series of seven pilot projects on marine pollution, the Coordinated Pollution Monitoring and Research Program, was established. The nineteen Mediterranean states are demonstrating admirable cooperation in this plan for regional pollution control. This is an important political and economic move, especially if the UN adopts a 370 km (200 mi) economic zone for the states, and in view of the complex demands for research, monitoring, planning, control, and abatement measures.

3. FOREIGN LEGISLATION

C-0309-78
CANADA'S PROCLAIMED 200-MILE FISHING LIMIT AND ENVIRONMENTAL IMPLICATIONS
Waldichuk, M. 1977.
Marine Pollution Bulletin 8(8):175-183.

*Fishing limit, Legislation, Surveillance, Fisheries, Pollution prevention, Canada

This report provides some background material leading up to Canada's establishment of a 370 km (200 nautical mi) fishing limit, and examines the fisheries and environmental implications. Marine pollution control will require special consideration under this zonation, with surveillance and application of existing legislation providing the means for avoiding such disasters as the Argo Merchant spill. Baseline studies are needed for future monitoring programs.

4. STANDARDS AND GUIDELINES

C-0310-78
DIRECTORY OF FEDERAL AND STATE WATER POLLUTION STANDARDS
Patterson, J.W. 1976.
Final report IIEQ-77-06. 331 p.

Legislation, Guidelines, Water quality, Industries, US, EPA, *Effluent limitations

This Directory brings together enacted legislation on effluent and water quality standards of the 50 states and EPA effluent limitation guidelines for industrial discharges. Direct comparison of the federal and state effluent limitations is made possible by conversion of the federal guidelines (promulgated on a mass discharge basis) to a concentration basis.

[from Government Reports Announcements 71(18): #PB-267 798/7GA. 1977.]

5. AGREEMENTS AND CONVENTIONS

C-0311-78
INTERVENTION ON THE HIGH SEAS (IN CASES OF POLLUTION): AN AMERICAN APPROACH EMPLOYING COMMUNITY STANDARDS
Bissell, W.K. 1976.
Journal of Maritime Law and Commerce 7(4):718-735.

International conventions, Pollution control, Contingency planning

The author analyzes the importance of the Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties. Attention is focussed on the community standards and functional approach applied to an exclusive coastal state activity, and on the need to develop competent contingency plans.

SECTION II: CURRENT RESEARCH PROJECTS

Title, contract information, and a summary of project objectives are provided in each entry. Project notices have been obtained from: the Smithsonian Science Information Exchange (SSIE); API Annual Report on Research Projects; Marine Research Information Service Abstracts; Scientific and Technical Aerospace Reports; Department of Environment, Canada, Spill Technology Newsletter; Northwest and Alaska Fisheries Center Monthly Report; and written inquiries to organizations and researchers. Current status information and publications resulting from the projects are presented when such information is available from the principal investigators or performing organizations. The source of status information is given at the end of each entry.

Entries are grouped according to subject and then ordered sequentially with a citation number R- -78. Some of the projects listed in previous Oil Pollution Reports have been recently renewed. These projects have been relisted with a current serial number, followed by the original number in parentheses. To locate the original entry, refer to the following list:

Citation Numbers	Dates Covered	Report Number
R-001-74 to R-165-74	July 74 - Oct. 74	EPA-670/2-75-003
R-166-74 to R-244-74	Nov. 74 - Feb. 75	EPA-670/2-75-044
R-245-74 to R-268-74	Feb. 75 - Apr. 75	EPA-670/2-75-059
R-269-74 to R-342-74	May 75 - July 75	EPA-600/2-76-129
R-269-75 to R-304-75	Aug. 75 - Oct. 75	EPA-600/2-76-113
R-001-76 to R-035-76	Nov. 75 - Jan. 76	EPA-600/2-76-185
R-036-76 to R-063-76	Feb. 76 - Apr. 76	EPA-600/2-76-215
R-064-76 to R-123-76	May 76 - July 76	EPA-600/2-76-266
R-124-76 to R-175-76	Aug. 76 - Oct. 76	EPA-600/2-77-037
R-001-77 to R-022-77	Nov. 76 - Jan. 77	EPA-600/2-77-075
R-023-77 to R-039-77	Feb. 77 - Apr. 77	EPA-600/2-77-111
R-040-77 to R-075-77	May 77 - July 77	Submitted to EPA 8/77
R-076-77 to R-096-77	Aug. 77 - Oct. 77	Submitted to EPA 11/77

A. OIL POLLUTION DETECTION AND EVALUATION

1. SAMPLING

R-001-78
PETROLEUM HYDROCARBON BASELINE FOR NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA

Principal Investigator:	MacLeod, W.D., and G. Snyder
Performing Organization:	NOAA National Analytical Facility, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, D.C. 20460
Period:	2/77 to 2/78

Sampling, Baseline studies, Chemical analysis, Mollusks, Sediments, Puget Sound

This study is being conducted as a preliminary baseline design program for the MESA Puget Sound Project. Research components include: 1) preliminary sampling investigation; 2) quarterly sampling of mussels (18 sites) and sediments (19 sites); 3) chemical analysis of composite samples to determine hydrocarbon concentrations; 4) frozen storage of duplicate samples for future analysis; and 5) interpretation of data.

Reports and Publications

The preliminary design report is available from the MESA Project Office. The final report is scheduled for March 1978.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager,
U.S. Dept. of Commerce, NOAA,
Environmental Research Laboratories,
MESA Puget Sound Project,
7600 Sand Point Way NE, Seattle, WA 98115

R-002-78 (R-077-77)
NEW APPROACHES TO THE PRESERVATION OF CONTAMINANTS IN WATER SAMPLES

Principal Investigator:	Saxena, J.
Performing Organization:	Syracuse University Res. Corp., Merrill Lane, University Heights, Syracuse, NY 13210
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research and Development, No. R80460901
Period:	9/76 to 8/79

Sampling, Contaminants, Wastewaters, Microorganisms, *Preservation

This project will test new methods of water sample preservation. Nitrogen and phosphorus series, oil, grease, and organic carbon are the sample parameters that will be stabilized. Four phases of study will encompass the following: 1) evaluation of the effectiveness of the proposed preservation methods in controlling microorganisms; 2) study of the stability of the contaminants in natural waters; 3) study of the effects of storage and transportation parameters on the preservation methods; and 4) simplification of the methods for field application, cost benefit analysis, and comparisons with currently used methods.

[SSIE No. GMA-3256]

Status: The first year of this three year project has been completed. Studies undertaken include the effect of antibiotics on cell growth and oxygen utilization, and the effectiveness of certain antibiotics in stabilizing the levels of nitrate, nitrite, and phosphate in municipal wastewaters. The second year research will be devoted to determination of the relative effectiveness of other preservatives in preventing changes in sample test parameters. Studies of the stabilization of phenols, oil and grease and ammonia in natural waters will be included.

Information Source: Dr. J. Saxena, Syracuse University Res. Corp.,
Merrill Lane, University Heights,
Syracuse, NY 13210

2. ANALYSIS

R-003-78 (R-079-77)

NAVY ENVIRONMENT: CHARACTERISTICS AND STABILITY OF COLLOIDAL MATERIAL ACCOMMODATING HYDROCARBONS IN THE OPEN OCEAN

Principal Investigator:	Zsolnay, A.
Performing Organization:	Bermuda Biological Station for Research, St. Georges, St. Georges West, Bermuda
Supporting Agency:	U.S. Department of Defense, Navy, No. DN675124, Contract N00014-76-C-0029
Period:	10/76 to 9/77
Funds:	$39,948

Hydrocarbons, Seawater, Benthos, Sediment, Chemical Analysis, *Transport

This project will study the contributions of organic compounds to characterize the chemical and biological properties of seawater, their role as an energy source for the benthic community, and their effect on sediment physiocochemical properties. The mechanism of transport of this material is emphasized. Seawater samples will be collected from the Sargasso Sea for fractionation of colloids and subsequent removal and chemical analysis of sorbed hydrocarbons.

[SSIE No. GQN-675124]

Reports and Publications

THE EFFECTS OF PELAGIC HYDROCARBONS ON THE ROCKY INTERTIDAL FLORA AND FAUNA OF BERMUDA
Maynard, N., C. Gebelein, and A. Zsolnay. 1977.
1977 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), New Orleans, March 8-10, 1977. p. 499-503.
(American Petroleum Institute No. 4284.)

BIOGENIC HYDROCARBONS IN THE INTERTIDAL COMMUNITIES OF THE ROCKY SHORES OF BERMUDA
Zsolnay, A., N. Maynard, and C. Gebelein. 1977.
1977 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), New Orleans, March 8-10, 1977.

CAUTION IN THE USE OF NISKIN BOTTLES FOR HYDROCARBON SAMPLES
Zsolnay, A. 1977.
Marine Pollution Bulletin. In press.

HYDROCARBON AND CHLOROPHYLL CORRELATION IN THE WATERS BETWEEN NOVA SCOTIA AND THE GULF STREAM
Zsolnay, A. 1977.
Deep-Sea Research Vol. 24:199-207.

INVENTORY OF NON-VOLATILE FATTY ACIDS AND HYDROCARBONS IN THE MARINE ENVIRONMENT
Zsolnay, A. 1977.
Marine Chemistry. In press.

LACK OF CORRELATION BETWEEN GAS-LIQUID CHROMATOGRAPH AND UV ADSORPTION INDICATORS OF PETROLEUM POLLUTION AND ORGANISMS
Zsolnay, A. 1977.
Water, Air, and Soil Pollution. In press.

SORPTION OF BENZENE ON PARTICULATE MATTER FROM THE SEA
Zsolnay, A. 1977
Rapports et Procès-verbaux des Réunions. Conseil International pour l'Exploration de la Mer Vol. 171:117-119.

TAR "SPECKS" FOUND IN THE NORTH ATLANTIC
Zsolnay, A. 1977.
Marine Pollution Bulletin 8(5):116-117.
For summary, see citation C-0302-78.

TOTAL AND AROMATIC HYDROCARBONS IN THE SURFACE WATER OF THE MEDITERRANEAN SEA: 1975
Zsolnay, A., B.F. Morris, and J.N. Butler. 1977.
Manuscript in preparation.

WEATHERING OF TAR ON A ROCKY SHORE OF BERMUDA
Zsolnay, A. 1977.
Submitted for publication.

Information Source: A. Zsolnay, Duke University Marine
Laboratory, Pivers Island,
Beaufort, NC 28516

B. OIL POLLUTION PREVENTION AND CONTROL

1. WASTE TREATMENT AND DISPOSAL METHODS

R-004-78

WASTEWATER EFFLUENT CHARACTERISTICS OF REFINERIES IN WASHINGTON STATE

Principal Investigator:	Pizzo, J.
Performing Organization:	Oceanographic Institute of Washington, Seattle, WA
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, D.C. 20460
Period:	5/76 to 11/76

Wastewater treatment, Refineries, Baseline studies, Crude oil, Puget Sound

Puget Sound oil refineries were assessed as potential sources in this hydrocarbon baseline study for the MESA Puget Sound Project. Each U.S. refinery was characterized as to: 1) amounts and sources of incoming crude oil; 2) operational processes; 3) types and quantities of refined products produced; 4) components of wastewater resulting from the refining processes; and 5) wastewater treatment processes.

Reports and Publications

WASHINGTON STATE REFINERIES: PETROLEUM, PETROLEUM DERIVATIVES AND WASTEWATER EFFLUENT CHARACTERISTICS
Oceanographic Institute of Washington. 1976.
Final Report, NOAA Contract No. 03-6-022-35189. Seattle, Washington, Oceanographic Institute of Washington, 1976. (Published as NOAA/ERL/MESA Technical Memorandum.)

This study was conducted in order to describe in detail the types of petroleum and petroleum derivatives that potentially could reach the waters of Puget Sound. This involved the collection and summary of available information on the chemical characteristics, amounts processed, and final disposal of crude oils, refined products, and wastewater effluents associated with the Puget Sound refineries.

Project Office Contact:	R.P. Kopenski
Information Source:	H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle WA 98115

2. CONTINGENCY PLANNING

R-005-78

OIL IN WASHINGTON: APPLICABILITY OF MODELS TO MARINE ENVIRONMENTAL QUESTIONS AND ECOLOGICAL IMPACTS

Principal Investigator:	Pizzo, J.
Performing Organization:	Oceanographic Institute of Washington, Seattle, WA.
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period:	5/76 to 10/76

Contingency planning, Models, Environmental effects, Resource management, Oil industry, Oil transport, State governments, Washington

As part of the MESA Puget Sound Project, research included: 1) description of alternatives for development of the petroleum industry in Puget Sound through 1985; 2) identification of governmental management questions regarding potential marine environmental impacts; and 3) presentation of potential model applications for problem solving in this area of resource management. Acceptability of damage risk from spills is found to be the central environmental question concerning oil transport and handling.

Reports and Publications

OIL IN WASHINGTON: APPLICABILITY OF MODELS TO MARINE ENVIRONMENTAL MANAGEMENT QUESTIONS AND ECOLOGICAL IMPACTS
Oceanographic Institute of Washington. 1976.
Seattle, Washington, Oceanographic Institute of Washington, 1976. Vol. I.

This study assesses the use of models to solve state and local governmental management questions which could arise from alternative developments of the petroleum industry in Puget Sound through 1985. The socio-economic impacts of potential oil spills are considered of primary importance. Risk, transport, and ecological models are developed; 9 conclusions and 7 recommendations are made.

Project Office Contact: R.P. Kopenski
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

C. ASPECTS OF OIL POLLUTION

1. BIOLOGICAL ASPECTS

R-006-78

DISTRIBUTIONS OF SUSPENDED MATTER IN NORTHERN PUGET SOUND AND HYDROCARBON ADSORPTIVE CHARACTERISTICS OF RIVERINE SUSPENDED PARTICULATES

Principal Investigators: Baker, E., J. Cline, and R. Feely
Performing Organization: Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration
Supporting Agency: U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period: 7/76 to 9/77

Crude oil, Food chain, Benthos, Adsorption, Distribution, Puget Sound, *Suspended particles

With greatly intensified tanker traffic in the Puget Sound region, the threat of significant additions of crude oil to the marine environment has prompted this study. The serious problems posed for the food chain through oil ingestion by the detrital feeders of the water column and the benthic deposit feeders are recognized. Research will focus on: 1) determination of suspended particulate loading in the waters of northern Puget Sound; 2) characterization of petroleum hydrocarbons presently adsorbed to suspended particles; 3) characterization of the ability of riverine suspended matter to adsorb Prudhoe Bay crude oil; and 4) determination of dissolved low molecular weight hydrocarbon concentrations.

Project Office Contact: R.P. Kopenski
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way, NE, Seattle, WA 98115

R-007-78

PHYSIOLOGICAL ECOLOGY OF THE OCEAN INSECT HALOBATES

Principal Investigator: Cheng, L.
Performing Organization: University of California, Scripps Institute of Oceanography, P.O. Box 1529, San Diego, CA 92038
Supporting Agency: National Science Foundation, Division of Ocean Sciences, 1800 G St. NW, Washington, DC 20550 No. OCE76-19786
Period: 11/76 to 10/77
Funds: $10,400

Insects, Hydrocarbons, *Pleuston, *Bio-indicator, *Halobates

The basic biology and physiological ecology of the pleustonic Halobates will be studied. Data from this research may contribute to using this insect as a sensitive bio-indicator of petroleum hydrocarbon and pesticide pollution.

[SSIE No. CH-B76.]

R-008-78
MARINE MAMMAL INVESTIGATIONS IN NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA

Principal Investigators:	Fiscus, C., R. DeLong, and R. Everitt
Performing ORganization:	Marine Mammals Division NWAFC/NMFS/NOAA
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development 401 M St. SW, Washington, DC 20460
Period:	11/77 to 2/79

Marine mammals, Distribution, Coasts, Puget Sound, *Harbor seal

The purpose of this study for the MESA Puget Sound Project is to characterize the marine mammal populations which are vulnerable to the increasing petroleum-related activities in this area. Emphasis will be placed upon the harbor seal population, and upon those coastlines most vulnerable to oil incursions.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

R-009-78 (R-096-77)
ENVIRONMENTAL DEGRADATION OF AIR FORCE CHEMICALS IN AIR, WATER AND SOIL

Principal Investigator:	Inman, R.C.
Performing Organization:	U.S. Air Force, Aerospace Medical Research Laboratory, Wright Patterson A.F.B., Dayton, OH 45433
Supporting Agency:	U.S. Department of Defense, Air Force, No. DF320520
Period:	10/76 to 9/77

Fuels, Fish, Toxicity, Acute effects, Chronic effects, WSF

The degradation of Air Force critical materials introduced into an aquatic or terrestrial environment and the degradation rate kinetics will be studied. Data will be used in compiling environmental impact statements or assessments on weapons systems using these chemicals.

[SSIE No. ZQF-320520]

Status: The latest annual report completed is titled "Environmental Quality Research Fish and Aufwuchs Bioassay" and was conducted by the University of California, Berkeley. The effects of the jet fuel JP-8 and hydrazine as potential environmental contaminants on freshwater and marine fish were evaluated. Acute and chronic bioassays on the toxicity of the WSF of JP-8 to the freshwater fish golden shiner and the marine flagfish were conducted. Results include the effect of pH on toxicity, egg hatchability, growth and development of fry, and tissue concentration.

Information Source: C.B. Harrah, Environmental Quality Branch, Toxic Hazards Division, 6570th Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio 45433

R-010-78
MEMBRANE TOXICITY THEORY AND ENVIRONMENTAL POLLUTANTS

Principal Investigator:	Kinter, W.B.
Performing Organization:	Mount Desert Island Biol. Lab., Old Bar Harbor Rd., Salsbury Cove, ME 04672
Supporting Agency:	U.S. Dept. of Health, Education & Welfare, Public Health Service; National Inst. of Health, National Inst. of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC 27709. No. R01 ES 00920-04
Period:	6/76 to 5/77
Funds:	$73,564 (FY 76)

Hydrocarbons , Toxicity, Birds, Fish, Health hazards, *Altered membrane

"The immediate objective is comprehensive physiological-biochemical-morphological evaluation of the effects of heavy metal, petroleum and organochlorine pollutants on osmoregulatory and nutritive membrane functions in selected species of aquatic birds and fish." The long-term objective is the evaluation of the role of altered membrane as one of the primary mechanisms of pollutant toxicity. The cell membrane theory of toxicity is an approach to: 1) explaining toxicities of known pollutants; 2) designing indicator tests for environmental warning; and 3) predicting future health hazards including synergistic effects.

[SSIE No. 1ES-920-4]

R-011-78

SEASONAL DISTRIBUTION OF PHYTOPLANKTON AND ZOOPLANKTON IN THE STRAIT OF JUAN DE FUCA

Principal Investigators:	Larrance, J., and D. Damkaer
Performing Organization:	Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period:	1/76 to 7/78

Plankton , Distribution, Intertidal zone, Baseline study, *Strait of Juan de Fuca

The purpose of this study for the MESA Puget Sound Project concerning oil pollution is to develop a broad characterization of the planktonic populations in the title area. Emphasis will be placed upon the ichthyoplankton and planktonic stages of intertidal organisms which represent economically valuable species. The major taxonomic groups, their horizontal and vertical distributions, and seasonal variability will be determined.

Reports and Publications

PUGET SOUND ENERGY-RELATED RESEARCH PROJECT, PLANKTON STUDIES
Chester, A., D. Damkaer, D. Dey, and J. Larrance. 1977.
Seattle, Washington, Pacific Marine Environmental Laboratory, 1977. Annual Report 1/76-1/77.

Plankton samples were taken in the Strait of Juan de Fuca to study community composition and distribution. Seven cruises during 1976 sampled phytoplankton, zooplankton, and ichthyoplankton.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

R-012-78

MARINE BIRD INVESTIGATIONS IN THE STRAIT OF JUAN DE FUCA AND NORTHERN PUGET SOUND

Principal Investigators:	Manuwal, D.A., and T.R. Wahl
Performing Organization:	College of Forest Resources, University of Washington
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, D.C. 20460
Period:	12/77 to 3/79

Birds, Habitat, Oil spills, Distribution, Puget Sound

The objective of this study is to characterize the marine bird populations of the title region and to identify sub-regions and/or habitats of significance to these populations. The vulnerability of these birds to potential oil spills increases the significance of this study for the MESA Puget Sound Project.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

R-013-78

COMMUNITY AND TROPHIC RELATIONSHIPS OF NEARSHORE FISH AT SELECTED SITES ALONG THE STRAIT OF JUAN DE FUCA

Principal Investigator:	Miller, B.
Performing Organization:	Fisheries Research Institute, University of Washington
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, D.C. 20460
Period:	4/1/76 to 5/31/78

Fish, Invertebrates, Distribution, Food web, Contamination, *Pollutant pathways, *Strait of Juan de Fuca

The objective of this study for the MESA Puget Sound Project is to characterize the main biological populations and processes most susceptible to oil pollution. The major predator/prey relationships and pollutant pathways within the food web will be documented. Emphasis will be placed on the invertebrates and fishes of nearshore habitats that are vulnerable to impact by petroleum.

Reports and Publications

NEARSHORE FISH AND MACROINVERTEBRATE ASSEMBLAGES ALONG THE STRAIT OF JUAN DE FUCA INCLUDING FOOD HABITS OF NEARSHORE FISH
Simenstad, C.A., B.S. Miller, J.N. Cross, K.L. Fresh, *et al*. 1977.
Annual Report, NOAA Contract No. 03-6-022-35185.
Seattle Washington, University of Washington, College of Fisheries, Fisheries Research Institute, 1977.

This baseline study for potential oil transport impacts documents the distribution, abundance, and biomass of nearshore fish in the title area; determines their food habits; and identifies and catalogues the macroinvertebrates collected incidentally with the fish. Seventy species of fish and 150 species of macroinvertebrates were collected; highest values were recorded in summer and spring respectively. Nearshore demersal fish fed predominantly upon epibenthic crustaceans; nearshore neritic fish fed upon pelagic invertebrates.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

R-014-78 (R-088-77)
ECOLOGICAL, PHYSIOLOGICAL, AND TOXICOLOGICAL EFFECTS OF OIL ON BIRDS

Principal Investigator:	Stickel, L.F.
Performing Organization:	U.S. Department of the Interior, Fish and Wildlife Service, Laurel, MD 20811
Supporting Agency:	U.S. Department of the Interior, Fish and Wildlife Service, Division of Population Reg. Res.; No. 85-830-9285-000
Period:	10/76 to 9/77
Funds:	$440,000

Fuel oil, Birds, Sublethal effects, Toxicity, Guidelines

The effect of sublethal exposure of birds to oil will be studied by correlating experimental and ecological studies that relate toxicological/physiological effects and kinetics of oil in birds to exposure in the environment. Recommendations will be made for guidelines to levels of oil in the environment that are dangerous to the welfare of wild bird populations.

[SSIE No.:ZUV-82]

Reports and Publications

EFFECTS OF EXTERNAL APPLICATIONS OF FUEL OIL ON HATCHABILITY OF MALLARD EGGS
Albers, P.H. 1977.
Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. D.A. Wolfe (ed.). New York, Pergamon Press, 1977. p. 151-157. Proceedings of a Symposium, Seattle, Washington, November 10-12, 1976.

Mallard eggs were coated with varying amounts (up to 50 μL) of No. 2 fuel oil and artificially incubated along with controls and eggs coated with other materials. Even very small amounts of fuel oil severely reduced the hatchability of the test eggs. Ducklings from the test eggs exhibited no gross external malfunctions or behavioral abnormalities but did show some growth inhibition, suggesting sublethal physiological damage or internal abnormalities.

EFFECTS OF EXTERNAL APPLICATIONS OF NO. 2 FUEL OIL ON COMMON EIDER EGGS
Szaro, R.C., and P.H. Albers. 1977.
Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. D.A. Wolfe (ed.). New York, Pergamon Press, 1977. p. 164-167. Proceedings of a Symposium, Seattle, Washington, November 10-12, 1976.

Eggs of the Common Eider (*Somateria mollissima*) were coated with up to 20 μL of No. 2 fuel oil and artificially incubated with other treated eggs and controls. Eggs treated with 5 μL and 20 μL fuel oil had hatching rates of 92% and 69%, respectively, as compared to 96% for the control group. Thus, oil pollution may significantly increase embryonic mortality in marine birds.

D. ASPECTS OF OIL EXPLORATION AND PRODUCTION

1. GENERAL ASPECTS

R-015-78 (R-021-77)
PUGET SOUND ENERGY RESEARCH

Principal Investigator:	Harris, H.S.
Performing Organization:	U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115
Supporting Agency:	U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460 No. B7121201
Period:	9/75 to 9/80 (est.)
Funds:	$295,800 (FY 76)

Oil transport, Refineries, Environmental effects, Hydrocarbons, Baseline studies, Movement, Models, Puget Sound

This project entails a 5-year study to make an environmental assessment of the potential effects of increased petroleum activities in the Puget Sound region. Current year plans include the initiation of surveys on petroleum hydrocarbon baseline concentration, biological populations, and physical oceanography; a mathematical model for predicting the movement of oilspills will also be developed.

[SSIE No. GMA-2901]

Status: The project is now entering its third year (of five). Original plans have been changed to eliminate development of a predictive ecosystem model as one of the objectives. Major reports will become available during 1978. The project conducts many research activities and those currently underway or recently completed are also abstracted in this Current Research Reports section.

Reports and Publications

PUGET SOUND MARINE ENVIRONMENT: AN ANNOTATED BIBLIOGRAPHY
Collias, E.E., and S.I. Andreeva. 1977.
Seattle, Washington, University of Washington Press, 1977.
Washington Sea Grant.

For summary, see citation R-020-78.

NEAR-SURFACE CIRCULATION STUDIES IN THE STRAIT OF JUAN DE FUCA
Holbrook, J.R., and D. Halpern. 1976.
Proceedings of the Fifth Technical Conference on Estuaries of the Pacific Northwest.

OBSERVATIONS OF NEAR-SURFACE CURRENTS IN THE STRAIT OF JUAN DE FUCA DURING FEBRUARY-MAY 1976
Holbrook, J.R., and D. Halpern. 1976.
Transactions of the American Geophysical Union, 57. (Poster Presentation.)

INTERTIDAL SEDIMENT HYDROCARBON LEVELS AT TWO SITES ON THE STRAIT OF JUAN DE FUCA
MacLeod, W.D., Jr., D.W. Brown, R.G. Jenkins, and L.S. Ramos. 1976.
Symposium on Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms. Seattle, Washington. November 11, 1976.

A PILOT STUDY ON THE DESIGN OF A PETROLEUM HYDROCARBON BASELINE INVESTIGATION FOR NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA
MacLeod, W.D., Jr., D.W. Brown, R.G. Jenkins, L.S. Ramos, and V.D. Henry. 1976.
NOAA Technical Memorandum ERL MESA-8. Boulder, Colorado, Marine Ecosystems Analysis Program Office, Environmental Research Laboratories, 1976. 53 p.

Increased tanker traffic in the title areas was the impetus for this study. Intertidal sediments, snails, and mussels from 2 physically similar regions were studied using the latest analytical techniques applied to C_{14}-C_{32} alkanes, or to aromatics from substituted benzenes through benzpyrenes. Results are discussed in relation to biogenic origin and fuel oil seepage; and 17 aromatic hydrocarbons are proposed for baseline monitoring.

AN ASSESSMENT OF THE METEOROLOGICAL STATIONS ALONG THE STRAIT OF JUAN DE FUCA
Marine EcoSystems Analysis Program Office. 1976.
NOAA Technical Memorandum ERL MESA-12. Boulder, Colorado, MESA Program Office, Environmental Research Laboratories, 1976. 31 p.

This paper is the initial report of a wind study being conducted as part of the Puget Sound Energy-Related Research Project (a project concerned with the increased petroleum transport and refinery operations in the Strait of Juan de Fuca and northern Puget Sound). The paper discusses the seasonal wind flow within the area, and analyzes the permanent meteorological networks in the U.S. and Canada. Also summarized are initial field activities undertaken to improve the understanding of the winds within the project area, for use in the long-term goal of spill trajectory and pollution prevention reports.

PROJECT DEVELOPMENT PLAN, AN ENVIRONMENTAL ASSESSMENT OF NORTHERN PUGET SOUND AND THE STRAIT OF JUAN DE FUCA
Marine EcoSystems Analysis Program Office. 1975.
Boulder, Colorado, Environmental Research Laboratories, 1975.

DATA MANAGEMENT PLAN FOR THE PUGET SOUND ENERGY-RELATED RESEARCH PROJECT AND THE MESA PUGET SOUND PROJECT
MESA Puget Sound Project Office. 1976.
Seattle, Washington, Environmental Research Laboratories, 1976.

WASHINGTON STATE REFINERIES: PETROLEUM, PETROLEUM DERIVATIVES AND WASTEWATER EFFLUENT CHARACTERISTICS
Oceanographic Institute of Washington. 1976.
Final Report, NOAA Contract No. 03-6-022-35189.
Seattle, Washington, Oceanographic Institute of Washington, 1976. (Published as NOAA/ERL/MESA Technical Memorandum.)

For summary, see citation R-004-78.

PHYSICAL OCEANOGRAPHY IN PUGET SOUND MAIN BASIN
Pacific Marine Environmental Laboratory.
Project Report: Fiscal Year 1976 and 1976T.

Continuous measurements of currents, temperatures, and salinity at several depths of the main basin of Puget Sound have been taken for several years in this study for the MESA Puget Sound Project which emphasizes the impact of wastewater and petroleum discharges. Three subtasks are reported on: regional meteorology modeling; surface current interpolation; and central basin dynamic modeling.

TIDAL HYDRODYNAMICS IN THE STRAIT OF JUAN DE FUCA - STRAIT OF GEORGIA
Parker, B.B. 1977.
NOAA Technical Report NOS 69. Rockville, Maryland, Office of Marine Surveys and Maps, 1977. 56 p.

Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project,
7600 Sand Point Way NE, Seattle, WA 98115

E. FATE OF OIL IN THE ENVIRONMENT

1. BIODEGRADATION

R-016-78
MICROBIAL DEGRADATION OF PETROLEUM HYDROCARBONS
Principal Investigator: Westlake, D.W.S.
Performing Organization: University of Alberta, Department of Microbiology
Supporting Agency: U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period: 4/77 to 6/78

Biodegradation, Crude oil, Microorganisms, Sampling, Puget Sound

This study for the MESA Puget Sound Project investigates the biodegradation of crude oil by mixed communities of microorganisms in the Strait of Juan de Fuca/northern Puget Sound area. Microorganisms are identified and rates and products of degradation are determined in laboratory experiments. Twelve sites are chosen for sampling three times a year.

Project Office Contact: E.R. Long
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

2. GENERAL FATE OF OIL

R-017-78
STRAIT OF JUAN DE FUCA AERIAL DROGUE STUDY
Principal Investigators: Ebbesmeyer, C.C., and J.M. Helseth
Performing Organization: Evans-Hamilton, Inc., Seattle, WA
Supporting Agency: U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period: 7/77 to 10/77

Oil slicks, Drift, Monitoring, Puget Sound, *Aerial drogue study, *Prediction

This study was undertaken as part of the MESA Puget Sound Project to help develop a predictive capability for oil spilled into the waters of the title area and northern Puget Sound. The study will support the extensive oceanographic current meter deployments which form the main effort in this area. Specifically, surface drifters of thin foam pads will be launched to simulate movement of oil slicks and tracked by air during daylight hours.

Project Office Contact: R.P. Kopenski
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

R-018-78

A FACILITY FOR THE EXPERIMENTAL ANALYSIS OF COASTAL MARINE ECOSYSTEMS

Principal Investigators: Knauss, J.A., S. Nixon, M. Pilson, Bender, T. Smayda, J. Griffin, F. Dimeglio
Performing Organization: University of Rhode Island, School of Oceanography, Administration Bldg., Wakefield, RI 02881
Supporting Agency: U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460 No. R803902
Period: 7/75 to 6/76

Ecosystems, Fuel oil, Fate, Biological effects, Models, Plankton , Benthos

The major objectives of this research are to: 1) develop a facility and methods for experimental analysis of coastal ecosystems and their response to energy-related environmental stresses, and 2) to use the data in ecosystem theory and management of coastal marine environments. After preliminary ecosystem study, experiments involving the addition of water soluble petroleum hydrocarbons at concentrations of 100 and 1000 μg/L will be conducted.

[SSIE No.: GMA-2735.]

Status: This project, now titled "Marine Ecosystems Research Laboratory" (MERL), is currently active and funded by EPA at approximately $1,000,000/year.

The first series of experiments with 9 marine microcosms ran from August 1976 to September 1977. Each microcosm contains 13 tons of water and 1 ton of sediment, providing biological and chemical components of planktonic and benthic systems. Two experiments on oil additions were performed. Quantitative information is being compiled on the effects of relatively low (150 μg/kg) chronic levels of fuel oil on the phytoplankton, zooplankton, and benthos; and on the fate of the oil in these systems.

A new series of experiments is underway and involves 12 microcosms.

Reports and Publications

THE MARINE ECOSYSTEMS RESEARCH LABORATORY: A FACILITY FOR THE INVESTIGATION OF EFFECTS AND FATES OF POLLUTANTS
Pilson, M.E.Q., G.A. Vargo, P. Gearing, and J.N. Gearing. 1977.
Proc. 2nd National Conf. Interagency Energy/Environment R & D Program, Washington, DC. 6-7 June, 1977. (in press)

The 12 meso-scale microcosms set up at the Laboratory are described. The ecosystems maintained in these tanks are intended to be typical of the N.E. coast of the United States and preliminary results indicate close correlation to benthic-planktonic systems in Narragansett Bay. The first oil experiment is briefly reported and use of the MERL tanks as quantitative tools is discussed.

Information Source: M.E.Q. Pilson, Director of MERL,
University of Rhode Island, Graduate School
of Oceanography, Kingston, RI 02881

R-019-78

OIL SPILL TRAJECTORY MODEL FOR PUGET SOUND, THE STRAIT OF JUAN DE FUCA, THE SAN JUAN ISLANDS, AND SOUTHERN GEORGIA STRAIT

Principal Investigator: Smyth, C.S.
Performing Organization: U.S. Dept. of Commerce, NOAA,
Pacific Marine Environmental Laboratory,
MESA Puget Sound Project
Supporting Agency: U.S. Environmental Protection Agency,
Office of Research & Development,
401 M St. SW, Washington, DC 20460
Period: 5/76 to 9/77

Models, Pollution prevention, Contingency planning, Puget Sound

The study objective is to develop an operational oil spill trajectory model which can be used in 2 modes: prespill - development of probable spill scenarios and resultant oil trajectories for clean-up planning; and postspill - real-time prediction for clean-up deployment purposes.

Status: A final report was scheduled for October, 1977, to include documentation of computer programs, listings, sample runs, a user's guide, and a review of testing and verification.

Project Office Contact: R.P. Kopenski
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project,
7600 Sand Point Way NE, Seattle, WA 98115

F. BIBLIOGRAPHIES

R-020-78
BIBLIOGRAPHY OF LITERATURE ON THE PUGET SOUND MARINE ENVIRONMENT
Principal Investigators: Collias, E.E., and A.C. Duxbury
Performing Organization: University of Washington, Dept. of Oceanography
Supporting Agency: U.S. Environmental Protection Agency, Office of Research & Development, 401 M St. SW, Washington, DC 20460
Period: 12/75 to 9/77

Bibliographies, Resource management, Pollution control, Oil industry, Puget Sound

A bibliography was prepared as part of the MESA Puget Sound Project in order to make existing environmental information available to regional decision makers and resource managers. The document should be available from the MESA Project Office in October, 1977 (7600 Sand Point Way NE, Seattle, WA 98115).

Publications and Reports

PUGET SOUND MARINE ENVIRONMENT: AN ANNOTATED BIBLIOGRAPHY
Collias, E.E., and S.I. Andreeva. 1977.
Seattle, Washington, University of Washington Press, 1977.
Washington Sea Grant.

Entries cover all of the oceanographic sciences as well as topics such as pollution, planning and management, transportation, industrial, and petroleum activities. There are 1980 annotated references to literature on the title subject published prior to January, 1977.

Project Office Contact: R.P. Kopenski
Information Source: H.S. Harris, Project Manager, U.S. Dept. of Commerce, NOAA, Environmental Research Laboratories, MESA Puget Sound Project, 7600 Sand Point Way NE, Seattle, WA 98115

SECTION III: CURRENT CONFERENCES

*Additional information not available at time of publication.

Aug. 21-26 33rd Annual Meeting of the Society for Industrial Microbiology, East Lansing, Michigan, 1977.

Oil Pollution Related Papers

Paper I31
NITRIFICATION OF PETROCHEMICAL WASTEWATERS
Ackerman, R.A., and S.L. Fialkoff

Commercially prepared nitrifying bacterial cultures (AT5N) were used to remove ammonia from a variety of petrochemical wastewaters. Tests were conducted to measure bacterial efficiencies, and the results are reported. Ammonia removals ranged from 60-75% over a period of 1-8 hours.

Paper I32
PERSISTENCE OF OIL IN TUNDRA SOILS
Sexstone, A.A., and R.M. Atlas

The persistence of crude oil in tundra soils was studied over a six-year period following experimental spills of Prudhoe crude oil at several sites. Relative rates of biodegradation, variations in the bacterial populations with time, and chemical changes in the residual oil compositions that were monitored over this time period are reported and discussed.

Paper I33
CRUDE OIL DEGRADATION IN THE ARCTIC: CHANGES IN BACTERIAL POPULATIONS AND OIL COMPOSITION DURING 1-YEAR EXPOSURE IN A MODEL SYSTEM
Horowitz, A., and R.M. Atlas

Rates of abiotic weathering and biodegradation of Prudhoe crude oil were monitored over a period of one year, following experimental spills under arctic conditions. Biodegradation lessened the weights of residual oils but did not alter the relative percentages of component hydrocarbon classes.

FFI contact the Society for Industrial Microbiology, c/o
American Institute of Biological Sciences, 1401 Wilson Blvd.,
Arlington, VA 22209

Aug. 22-26 International Symposium on Microbial Ecology, University of Otago, Dunedin, New Zealand, 1977.
Sponsored by the Royal Society of New Zealand, the New Zealand Microbiological Society, UNEP, UNESCO, ICRO, IAMS, IUMS, and ICOME

Oil Pollution Related Papers

Paper A21
THE FORMATION OF OIL EMULSIFYING AGENTS BY HYDROCARBONOCLASTIC BACTERIA
Floodgate, C.D.

Paper A26
AN ASSESSMENT OF THE BIODEGRADATION OF PETROLEUM IN THE ARCTIC
Atlas, R.M.

Paper A27
THE BIODEGRADATION OF WATER-INSOLUBLE HYDROCARBONS
Henderson, C., D. Alani, and G. Goma

Paper E27
TOXICOLOGICAL ASPECTS OF MICROBE-PETROLEUM INTERACTIONS
Walker, J.D.

FFI contact Dr. M.W. Loutit, Symposium Secretary, Department of Microbiology, University of Otago, Dunedin, New Zealand

Aug. 28-31 2nd Pacific Area Chemical Engineering Conference (PACHEC), Denver, Colorado, 1977.

Oil Pollution Related Papers

Session 1: Symposium. Reuse and Treatment of Industrial Wastewater

Paper 1b
OPTIMIZING WATER REUSE IN A PETROLEUM REFINERY
Kuriyama, T., N. Takama, K. Shiroko, and T. Umeda

Water reclamation and reuse can greatly decrease water consumption and the size of effluent treatment facilities. Maximizing or optimizing water reuse in order to minimize costs must consider the minimally acceptable water quality in addition to quantity. Theoretical and practical solutions to a water reuse problem in a petroleum refinery are presented.

Session 18: Symposium. Environmental Aspects of Shale Oil Production and Processing. Part 2

Paper 18a
OIL SHALE MINING AND THE ENVIRONMENT
Rajaram, V., T.A. Kauppila, and R.L. Bolmer

Described is a US Bureau of Mines demonstration mine in the deep, thick oil shale deposits of Colorado, and the four mining concepts that are to be used. The interrelationship of these concepts and environmental aspects of oil shale development are discussed.

Paper 18b
DISPOSAL OF MINE WATER FROM DEEP OIL SHALE MINE
Sinor, J.E.

Water disposal alternatives that were explored for the development of a room and pillar mine and a surface retorting complex are given. Results of a hydrological test of water inflow to the mine are discussed and results of a computer model study are presented.

Paper 18d
INTERACTIONS BETWEEN GROUND WATER AND IN-SITU RETORTED OIL SHALE
Parker, H.W., R.M. Bethea, N. Guven, M.N. Gazdar, and J.C. Watts

The interactions of groundwater with in-situ retorted shale are described. Such interactions are site-specific because wide variations exist in the amounts and species of dissolved solids in waters adjacent to shale formations, as well as the minerals contained in the oil shale. In addition there are significant mineral differences in mineral species extracted by different methods.

Paper 18e
ENVIRONMENTAL PLANNING FOR ERDA'S OIL SHALE TECHNOLOGY PROGRAM: STATEMENT OF PROBLEM
Powderly, J., M.J. Reilly, H. Thomas, and C.B. Wilson

ERDA's initial assessments of environmental problems associated with its current oil shale program are presented. The ERDA technology research, development, and demonstration program has the responsibility to develop environmentally acceptable technologies, and in response to this need is preparing an Environmental Development Plan for each of its technology programs.

Session 27: Symposium. The Environmental Aspects of Coal Conversion

Paper 27a
BASELINE GEOCHEMISTRY: HOW IT CAN ASSIST IN ANTICIPATED ENVIRONMENTAL PROBLEMS ASSOCIATED WITH OIL SHALE PROCESSING
Klusman, R.W., and C.D. Ringrose

A geochemical baseline is being developed for a variety of materials associated with oil shale. The determination of the geochemical character of the oil shale resource, overburden materials, soils, stream sediments and natural waters are considered most important. The data collected indicate that an understanding of regional geochemistry will have predictive value in assessing the types and magnitudes of environmental hazards that may be associated with oil shale development in a given area.

Paper 27b
REHABILITATION POTENTIAL AND PRACTICES OF COLORADO OIL SHALE LANDS
Sims, P.L., and E.F. Redente

Exploited oil shale areas should be restored to stable and functional ecosystems that can perpetuate themselves over time without requiring continual and periodic inputs of limited resources. "In essence, lands must ultimately be rehabilitated to a state where ecosystems are functional, productivity is sustained under reasonable levels of utilization by domestic and wild herbivores, provide habitat for animal populations at all trophic levels, and provide recreation and aesthetic values to man."

Paper 27c
PURIFICATION AND RECOVERY OF ECONOMIC MATERIALS FROM OIL SHALE RETORT WATER BY AN ELECTROLYTIC TREATMENT PROCESS
Wen, C.S., and T.F. Yen

The methodology of electrolytic treatment for the purification and recovery of valuable materials from retort water is presented. In the process, a water sample is delivered to an electrolytic cell and treated at a current density sufficient to decrease the concentration of organic compounds in the anodic chamber and to concentrate the organic and inorganic materials in the cathodic chamber.

Paper 27d
HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC CHARACTERIZATION OF OIL SHALE RETORT WATERS
Felix, W.D., D.S. Farrier, and R.E. Poulson

Analytical procedures required for the rapid quantitative determination of organic solute alteration in oil shale retort waters are discussed. Alterations occur during long-term storage by photolytic, thermal, chemical, and microbial action, and high-performance liquid chromatography procedures ha[illegible] developed to monitor such chemical changes in the ret[illegible]ers.

Session 45. [illegible]posium. Environmental Aspects of Tar Sands Processing

Paper 45a
RECLAMATION OF DISTURBED LAND AT GREAT CANADIAN OIL SANDS
Cary, W.L., and T.D. Shopik

The practical application of land restoration techniques developed at an operating oil sands plant is described. The details of numerous successes and failures in developing this methodology for overburden and tailings sand dykes in a northern boreal forest ecology are presented.

Paper 45b
THE ENVIRONMENTAL IMPACT OF OIL SANDS PROCESSING ON LAND RECLAMATION
Lang, D.D.

Successful and productive land surface reclamation is very difficult in areas where the Hot Water (Clark) Process for oil sands processing has been used. This paper concludes that greater emphasis must be placed on devising a process which reduces the need for water and produces a relatively dry waste product that can be incorporated into the land restoration process.

FFI contact Mr. Joel Henry, AIChE, 345 East 47th St., New York, NY 10017

Sept. 26-30 POAC 77, 4th International Conference on Port and Ocean Engineering under Arctic Conditions, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, 1977

Oil Pollution Related Papers

Sessions C-1 and C-2: Offshore Development and the Environment

OFFSHORE DEVELOPMENT FOR OIL AND GAS IN ANTARCTICA
Splettstoesser, J.F.

PETROLEUM EXPLORATION IN SVALBARD (SPITZBERGEN)
Pedersen, G.S.

APPLICATION OF AN OIL SPILL VULNERABILITY INDEX TO LOWER COOK INLET, ALASKA
Hayes, M.O., J. Michel, and P.J. Brown

BUZZARDS BAY OIL SPILL--AN ARCTIC ANALOG
Ruby, C.H., L.G. Ward, L.A. Fischer, and P.J. Brown

OILSIM, A COMPUTER MODEL FOR SIMULATING THE BEHAVIOUR OF OIL SPILLS
Willums, J.O., A. Westeng, T. Gloersen, T. Audunson, and O. Mundheim

Session C-3 and C-4: Physical Oceanography and the Environment

ENVIRONMENTAL STUDIES OF PORT VALDEZ, ALASKA
Colonell, J.M.

Proceedings are available from the Ocean Engineering Information Center, Memorial University of Newfoundland, St. John's, Newfoundland, Canada

Sept. 28-30 2nd International Symposium on Polynuclear Aromatic Hydrocarbons, Battelle Columbus Labs, Columbus, Ohio, 1977
Sponsored by EPA, Hoffman-LaRoche, Inc., and Battelle Memorial Institute

The symposium focused on the measurement, chemistry, metabolism, and carcinogenesis of polynuclear aromatic hydrocarbons.

Oil Pollution Related Papers

Session 1-Chemistry

PAH FROM FOSSIL FUEL CONVERSION PROCESSES
Guerin, M.R., J.L. Epler, B.R. Clarke, and W.H. Griest

A COMPARISON OF SOME CHROMATOGRAPHIC METHODS FOR ESTIMATION OF PAHS IN POLLUTANTS
Burchill, P., A.A. Herod, R.G. James, and J. Owen

ANALYSIS OF PAHS IN ENVIRONMENTAL SAMPLES BY GLASS CAPILLARY GAS CHROMATOGRAPHY
Bjorseth, A.

Session 3-Chemistry

RECENT ADVANCES IN GC AND GC-MS ANALYSIS OF PAHS
Hites, R.A.

HIGH RESOLUTION MATRIX ANALYSIS OF PAHS IN ENVIRONMENTAL SAMPLES
Levins, P.

CAPILLARY COLUMN GC-MS ANALYSIS OF PAHS IN AQUEOUS INDUSTRIAL EFFLUENTS
Strup, P.E., J.E. Wilkinson, and P.W. Jones

Session 5-Chemistry

METHOD FOR PAH ANALYSIS IN MARINE ENVIRONMENTS
Wise, S., S. Chesler, H. Hertz, and W. May

FFI contact Peter W. Jones, Battelle's Columbus Laboratories,
505 King Ave., Columbus, OH 43201

Oct. 3-7 7th International Colloquium on Medical Oceanography, Nice, France, 1977
Sponsored by the International Association of Medical Oceanography

Oil Pollution Related Papers

Session 4: Measurement of the Chemical Contamination of Sea-water Sediments and Marine Organisms

SAMPLING OF HYDROCARBONS IN POLLUTED WATERS: BIBLIOGRAPHY, DESCRIPTION OF A SAMPLER, COMMENTS
Carsin, J.L.

Session 6: Physiological and Biochemical Techniques for Studying the Marine Pollution

THE EFFECTS OF HYDROCARBONS UPON THE PHYSIOLOGY OF MUSSEL'S LARVAE: TECHNICAL STUDIES
Le Roux, S., and A. Lucas

FFI contact Dr. M.J. Gauthier, General Secretary, C.E.R.B.O.M.,
Parc de la Cote, 1 Avenue Jean Lorrain, 06300 Nice, France

Oct. 4-8 OCEANEXPO 77: 3rd Triennial International Exhibition on the exploration of the Oceans, Offshore Techniques, Ship-Building, Sea Harbors and Equipment, Bordeaux, France, 1977

Oil Pollution Related Papers

Session on Advanced Techniques for the Control of Pollution of the Seas

REMOTE SENSING AND PRACTICAL APPLICATIONS IN AN OPERATIONAL FRENCH ORGANIZATION
(Author unknown)

FRENCH NAVY PARTICIPATION IN THE CONTROL OF POLLUTION BY THE TANKER BOEHLEN
(Author unknown)

ADAPTATION OF ADVANCED OPERATIONAL TECHNIQUES EXISTING IN FRANCE IN THE FIELD OF APPLIED AERIAL REMOTE SENSING
(Author unknown)

DETECTION OF HYDROCARBON LAYERS BY AIRBORNE LATERAL RADAR WITH REAL ANTENNA AND SYNTHETIC ANTENNA
(Author unknown)

THE CONTRIBUTION OF TELEVISION TECHNIQUES IN THE FIELD OF THE TELEDETECTION OF MARINE POLLUTION
(Author unknown)

THE FRENCH "ARGOSS" SYSTEM OF DATA GATHERING AND LOCALISATION BY SATELLITE
(Author unknown)

FFI contact OCEANEXPO, 8 rue de la Michodière, 75002 Paris, France

*Oct. 24-27 European Offshore Petroleum Conference and Exhibition, London, 1977
Sponsored by the Society of Petroleum Engineers, and the Institute of Petroleum, London

FFI contact Sherry Anderson, 6200 North Central Expressway, Dallas, TX 75206

*Nov. 1-3 38th Annual International Water Conference, Pittsburgh, Pennsylvania, 1977

FFI contact the Engineers' Society of Western Pennsylvania, William Penn Hotel, 530 William Penn Place, Pittsburgh, PA 15219

*Nov. 29-30	3rd International Conference on Environmental Problems of the Extractive Industries: Materials, Energy, and Environment, Today and Tomorrow, Dayton, Ohio, 1977 FFI contact Dr. Patrick Sweeney, 1390 Rawlings Drive, Fairborn, OH 45324
*Jan. 9-12	Seminar on Marine Remote Sensing Instrumentation, Houston, Texas, 1978 FFI contact Mr. David Harvey, Harvey-Lynch, Inc., 7350 Harwin, Houston, TX 77036
Feb. 21-26	International Conference of Water Pollution Control in Developing Countries, Bangkok, Thailand, 1978 Sponsored by the Asian Institute of Technology, Canadian International Development Agency, and International Association on Water Pollution Research The conference includes topics on water pollution, monitoring, assessment, control, analysis, water quality aspects, wastewater recovery, and wastewater reclamation and reuse. FFI contact E.A.R. Ouano, Asian Institute of Technology, PO Box 2754 Bangkok, Thailand
*Feb. 26-Mar. 2	107th Annual Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Denver, Colorado, 1978 FFI contact AIME, 345 East 47th St., New York, NY 10017
Feb. 27-Mar. 3	29th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Cleveland, Ohio, 1978 Topics include environmental analysis and water pollution. FFI contact Robert W. Baudoux, Program Chairman, The Pittsburgh Conference on Analytical & Applied Spectroscopy, 4400 Fifth Ave., Pittsburgh, PA 15213
*Mar. 5-10	Oceanology 78 Conference, Brighton, England, 1978 FFI contact BPS Exhibitions Ltd., 4 Seaford Court, 220-222 Great Portland St., London W1N 5HH, UK

*Mar. 6-7 1st World Recycling Congress, Basle, Switzerland, 1978

FFI contact Exhibitions for Industry, Ltd., 157 Station Rd. East, Oxted, Surrey, UK

Mar. 12-17 175th American Chemical Society National Meeting, Anaheim, California, 1978

Oil Pollution Related Papers

Environmental Session

TOXICOLOGICAL SCREENING OF FOSSIL FUEL PROCESSING EFFLUENTS
(Author unknown)

Fuel Session

ENVIRONMENTAL ASPECTS OF FOSSIL FUEL PROCESSING
(Author unknown)

FFI contact A.T. Winstead, ACS, 1155 16th St., NW, Washington, DC 20036

*Mar. 14-16 Symposium on Technical, Environmental, Socio-Economic and Regulatory Aspects of Coastal Zone Planning and Management, San Francisco, California, 1978

FFI contact Orville T. Magoon, Program Chairman, PO Box 26062, San Francisco, CA 94126

*Apr. 5-7 8th Annual Symposium on the Analytical Chemistry of Pollutants, Geneva, Switzerland, 1978

FFI contact the Congress Secretariat, PO Box 182, CH-4013, Basle, Switzerland

*Apr 5-7 American Chemical Society 12th Middle Atlantic Regional Meeting, Hunt Valley, Maryland, 1978

FFI contact F. Gornick, Department of Chemistry, University of Maryland, Baltimore, MD 21228

*Apr 10-13 9th Materials Research Symposium on Trace Organic Analysis: A New Frontier in Analytical Chemistry, Gaithersburg, Maryland, 1978
Sponsored by the National Bureau of Standards

FFI contact Stephen Chesler or Harry Hertz, Chemistry Bldg., Rm A105, National Bureau of Standards, Washington, DC 20234

Apr. 11-13 6th Annual Industrial Pollution Conference, St. Louis, Missouri, 1978
Sponsored by the Water and Wastewater Equipment Manufacturers Association

The general conference theme is resource recovery and conservation with emphasis on wastewater treatment in various industries including the petroleum and petrochemical industries.

FFI contact Frederick Harroun, WWEMA, 7900 Westpark Dr., Suite 304, McLean, VA 22101

Apr. 17-20 24th Annual Institute of Environmental Sciences Technical Meeting and Equipment Exposition, Fort Worth, Texas, 1978

The meeting features seminars, tutorials and papers on diverse topics including environmental impact of energy resources, environmental pollution and impact statements, and biosciences and contamination problems.

FFI contact the Institute of Environmental Sciences, 940 East Northwest Highway, Mt. Prospect, IL 60056

*Apr. 27-28 Canadian Chromatography Conference, Montreal, Quebec, 1978

FFI contact V.M. Bhatnagar, PO Box 1779, Cornwall, Ontario K6H 5V7, Canada

May 5-13 Energy Economics Seminar, Tunbridge Well, United Kingdom, 1978
Organized by the Institute of Petroleum, London

The seminar is primarily for government and oil industry planners, financial analysts and management personnel. Environmental and socio-economic topics relevant to energy policies in the North Sea and surrounding areas are included.

FFI contact Lynda Boothby, Conference Officer, Institute of Petroleum, 61 New Cavendish St., London WIM 8AR, UK

May 8-11 Offshore Technology Conference, Houston, Texas, 1978

The conference includes papers on offshore environmental problems.

FFI contact William Nicholson, Offshore Technology Conference, 6200 N. Central Expressway, Dallas, TX 75206

*May 8-11 43rd Midyear Refining Meeting, Toronto, Ontario, 1978

FFI contact the American Petroleum Institute Refining Department, 2101 L St., NW, Washington, DC 20037

*May 17-18 Task Committee on Cold Regions "Applied Techniques for Cold Environments," Anchorage, Alaska, 1978
Sponsored by the American Society of Civil Engineers

FFI contact the ASCE, 345 East 47th St., New York, NY 10017

*May 24-25 The Sublethal Effects of Pollutants in the Sea, London, England, 1978

FFI contact the Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, UK

May 23-25 International Symposium on the Analysis of Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment, McMaster University, Hamilton, Ontario, Canada, 1978
Organized by the Canada Centre for Inland Waters, Burlington, Ontario, and the Institute for Environmental Studies, University of Toronto

The presentations deal exclusively with hydrocarbons or halogenated hydrocarbons in the hydrologic cycle, as may occur in the water column, sediments, or atmosphere.

Papers focus on the topics of:

1) Analytical techniques to determine concentrations, chemical species, or form (dissolved, particulate, absorbed, or emulsified)
2) Sampling methods
3) Monitoring programs
4) Rates and mechanisms of transport and transformation
5) Biological or ecological effects
6) Health effects

FFI contact the Canada Centre for Inland Waters, PO Box 5050, Burlington, Ontario L7R 4A6, Canada

June 4-8 85th AIChE National Meeting and First Chemical Plant Equipment Exposition, Philadelphia, 1978

The conference includes a Fuels and Petrochemicals Session, and an Environmental Program, with 6 sessions on industrial wastewater recycle and reuse, and refinery/petrochemical wastewater treatment.

FFI contact A.A. Winkler, Meetings Program Chairman, CPC International, Moffett Technical Center, PO Box 345, Argo, IL 60501

June 12-16 9th International Conference of the International Association on Water Pollution Research, Stockholm, Sweden, 1978

Oil Pollution Related Paper

THE UPTAKE AND RELEASE OF PETROLEUM HYDROCARBONS BY THE MARINE MUSSEL MYTILUS EDULIS
Hansen, N., V.B. Hensen, H. Appelquist, and E. Morch

FFI contact IAWPR, Chichester House, 278 High Holborn,
London WC1V 7HE, UK

June 14-17 Conference on Assessment of Ecological Impacts of Oil Spills, Keystone, Colorado, 1978
Organized by American Institute of Biological Sciences, and sponsored by API, BLM, USCG, EPA, ERDA, and NOAA

The objectives of the conference are to present a review of current assessments of the ecological impact of oil spills in the estuarine and marine environments and to discuss techniques and procedures involved in making assessments. Invited papers concentrate on a case-by-case analysis of the environmental impact of several recent spills, including the *Argo Merchant*, *Bouchard 65*, Ekofisk, *Hawaiian Patriot*, *Metula*, *Sansinema*, and *Nepco Barge*. Contributed papers will cover the following areas:

1) Ecological effects of oil spills on wildlife
2) Ecological effects of oil spills on water column organisms
3) Ecological effects of oil spills on benthic organisms
4) Ecological effects of oil spills in extreme zones, *i.e.*, the tropics and the arctic
5) Socio-economic aspects of oil spills

FFI contact the American Institute of Biological Sciences,
Special Science Programs, 1401 Wilson Blvd., Arlington,
VA 22209

*June 19-20 Symposium on Measurement of Organic Pollutants in Water and Wastewater, Denver, Colorado, 1978

FFI contact Jane B. Wheeler, ASTM, 1916 Race St., Philadelphia,
PA 19103

MASTER LIST OF KEYWORDS

S: See
SA: See also

Absorption
Activated sludge
Acute effects
Adriatic Sea
Adsorption
Aegean Sea
Africa
Alabama
Alaska
Alaska coast
Alaska, Gulf of
Algae ... SA: Phytoplankton
Analytical techniques ...
  SA: Chemical analysis; Source identification
Animals
Annelida ... SA: Polychaetes
Antarctica
API
Arabian Sea
Arctic
Arctic Ocean
Argentina
Argo Merchant Spill
Aromatic hydrocarbons ...
  SA: Hydrocarbons; PAH
Asia
Atlantic coast
Atlantic Ocean
Australia
Bacteria
Bahamas
Ballast
Baltic Sea
Bantry Bay
Barent Sea
Baseline studies
Beaches
Beaufort Sea
Behavior
Belgium
Bengal, Bay of
Benthos
Bering Sea
Bibliographies
Bilges
Biodegradation
Biological effects ... SA:
  Toxicity; Acute effects; Chronic effects
Biological treatment
Biomass
Birds
Biscay, Bay of
Black Sea
BLM
Blowout prevention
Blowouts
Booms
Brazil
California
California, Southern
Canada
Carcinogens ... SA: Health Hazards;
  PAH
Caribbean Sea
Caspian Sea
Chedabucto Bay
Chemical analysis ... SA: Analytical
  techniques; Source identification
Chemical effects
Chesapeake Bay
Chile
China
Chromatography
Chronic effects
Coalescence
Coasts
Colorado
Compensation
Connecticut
Conservation
Contaminants
Contamination
Contingency planning
Corals
Coral reefs
Cost analysis
Crankcase oil
Crude oil
Crustaceans
Decomposition

Delaware
Delaware Bay
Denmark
Design-engineering
Detection ... SA: Monitoring; Chemical analysis
Development ... SA: Offshore development
Dispersants
Dispersions
Disposal ... SA: Waste oil disposal; Wastewater disposal
Distillation
Distribution
Drift ... SA: Movement; Spreading
Drilling ... SA: Offshore drilling; Oil wells
East China Sea
Echinoderms
Economic effects
Economics ... SA: Cost analysis
Ecosystems
Ecuador
Effluent treatment ... S: Wastewater treatment
EIS
Ekofisk blowout
Emulisification
Emulsifiers
Emulsions
Engineering ... S: Design-Engineering
England
English Channel
Environmental deterioration
Environmental effects
Environmental Impact Statement ... S: EIS
Environmental management
Environmental protection
EPA
Equipment
ERDA
Estuaries
Evaporation
Exploration ... SA: Offshore exploration; Production
Extraction
Fate
FEA
Filtration ... SA: Flocculation; Ultrafiltration
Finland
Fish
Fisheries
Flocculation ... SA: Filtration
Florida
Flotation
Food web
Foreign governments
Fossil fuels
France
Freshwater
Fuel oil
Fuels
Fungi
Gas, liquid chromatography ... S: Chromatography
Gasoline
Georges Bank
Georgia
Germany, East
Germany, West
Gibraltar, Strait of
Government agencies ... SA: U.S. Government, State governments
Gravity separation
Great Lakes
Greenland
Groundwater
Guidelines ... SA: Manuals
Habitat
Harbors
Health hazards ... SA: Carcinogens
Hydrocarbons ... SA: Aromatic hydrocarbons; Crude oil; PAH
Ice
IMCO
Incineration
India
Indian Ocean
Indonesia
Industries ... SA: Oil industry
Information systems
Infrared spectroscopy ... S: Spectroscopy
Inland
Insurance
International agreements
International conventions ... SA: Regulations; Legislation
Intertidal zone

Invertebrates
Iran
Iraq
Ireland
Israel
Italy
Japan
Japan, Sea of
Kentucky
Korea/South
Kuwait
Labrador Sea
Lakes ... SA: Great Lakes
Latin America
Law enforcement
Leakage
Legislation ... SA: Regulations; International conventions
Liability
Louisiana
Lubricating oil
Magellan, Strait of
Maine
Malaysia
Manuals ... SA: Guidelines
Marine mammals
Marine organisms
Marshes
Maryland
Massachusetts
Mass spectroscopy ... S: Spectroscopy
Mediterranean Sea
Metabolism
Metula spill
Mexico
Mexico, Gulf of
Michigan
Microorganisms ... SA: Algae; Bacteria; Fungi; Yeasts
Middle East
Mississippi
Mississippi River
Models
Mollusks
Monitoring ... SA: Detection; Remote sensing; Sampling
Mortality
Movement ... SA: Spreading; Drift
Narragansett Bay
Natural seepage
Netherlands
Neuston
New Hampshire
New Jersey
New Mexico
New York
Niche
NOAA
North Carolina
North Sea
North Vietnam
Norway
Norwegian Sea
Oceans
OCS
Offshore development
Offshore drilling
Offshore exploration
Offshore production
Ohio
Oil ... S: Crude oil; Fuel oil; Lubricating oil; Crankcase oil; Waste oil
Oil discharges
Oil fields ... SA: Production
Oil-gas leasing
Oil industry
Oil shale
Oil slicks
Oil spills
Oil tanks
Oil terminal
Oil transfer
Oil transport
Oil-water separation ... SA: Wastewater treatment
Oil wells ... SA: Drilling; Production; Offshore drilling; Offshore production
Okhotsk, Sea of
Olympic Games spill
Onshore impacts
Oregon
Oxidation ... SA: Biodegradation; Weathering
Pacific Ocean
PAH
Patent
Pennsylvania
Personnel training
Petrochemicals
Petroleum ... S: Crude oil
Petroleum industry ... S: Oil industry

Petroleum products
pH control
Philippines
Physical effects
Phytoplankton
Pipelines
Plankton ... SA: Phytoplankton; Zooplankton
Plants ... SA: Vegetation
Platforms
Poland
Pollution control
Pollution prevention ... SA: Environmental protection; Contingency planning
Polychaetes
Ports
Portugal
Precipitation
Production ... SA: Offshore production; Drilling; Offshore drilling
Puerto Rico
Puget Sound
Reclamation ... SA: Recycling; Reuse
Recycling ... SA: Reclamation; Reuse
Red Sea
Refineries
Refining
Regulations ... SA: Legislation; International conventions
Release
Remote sensing ... SA: Monitoring; Detection
Reproduction
Residual Oils
Resource management
Restoration
Reuse ... SA: Reclamation; Recycling
Rhine River
Rhode Island
Rivers
Ross Sea
Safety
Sampling ... SA: Monitoring; Detection
San Francisco Bay
Santa Barbara Channel
Sargasso Sea
Saudi Arabia
Scotland
Sea surface
Seawater
Sedimentation
Sediments
Segregated ballast
Ships ... SA: Tankers
Shorelines
Sinking agents
Skimmers
Sludge ... SA: Activated sludge
Social effects
Socio-economic effects
Soil
Solid wastes
Solubility
Solution
Solvents
Source identification
Sources
South Africa
South Carolina
South China Sea
Spain
Spectrometry
Spectroscopy
Spill cleanup
Spill containment
Spill disposal
Spill recovery
Spreading ... SA: Movement; Drift
St. Lawrence River
Standing crop
State governments ... SA: U.S. Government; Government agencies
Statistical analysis
Statistics
Storage
Streams
Subarctic regions
Sublethal effects
Superports ... S: Ports
Supertankers ... S: Tankers
Surfactants
Surveillance
Sweden
Syria
Tankers ... SA: Ships
Tar

Tar sands
Texas
Torrey Canyon
Toxicity ... SA: Biological effects
Tropical regions
Turkey
UK
Ultrafiltration ... SA: Filtration
UN
Uptake
Urquiola spill
US
USCG
US Government ... SA: State governments; Government agencies
USGS
USN
USSR
Vegetation ... SA: Plants
Venezuela
Vertebrates
Vietnam
Virginia
Virgin Islands
Wales
Washington
Waste oil
Waste oil disposal ... SA: Disposal
Waste oil treatment
Wastewaters
Wastewater disposal ... SA: Disposal
Wastewater treatment
Water quality
Water soluble fractions ... S: WSF
Weathering
Weddell Sea
West Indies
Wildlife
WSF
Yeasts
Yugoslavia
Zooplankton

SUBJECT INDEX

THE SUBJECT INDEX IS A PERMUTED INDEX THAT LISTS ALPHABETICALLY THE KEYWORDS AND CORRESPONDING CITATION NUMBER ASSIGNED TO EACH ABSTRACT IN SECTION I (C- -78) AND IN SECTION II (R- -78). THESE KEYWORDS ARE SELECTED FROM THE MASTER LIST, P. 147. FREE LANGUAGE TERMS WHICH ARE INCLUDED TO GIVE MORE SPECIFIC INFORMATION ABOUT AN ENTRY ARE PRECEDED BY AN * SIGN IN THE SUBJECT INDEX.

0068 ABSORPTION, SPILL CLEANUP, *SORBENT BROADCASTER,
0071 ABSORPTION, SPILL CLEANUP, *KAPOK FIBER,
0073 ABSORPTION, SPILL CLEANUP, PATENT, *PLANT FIBER MAT,
0126 ABSORPTION, WASTEWATER TREATMENT, REFINERIES, DETECTION, *ACTIVATED CARBON,
0090 ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES, PATENT,
0131 ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES, PETROCHEMICALS, FLOCCULATION, FLOTATION,
0175 ACUTE EFFECTS, MARINE ORGANISMS, TOXICITY, ARCTIC, SUBARCTIC REGIONS, *BIOASSAYS,
0178 ACUTE EFFECTS, FUEL OIL, WSF, HYDROCARBONS , FISH, BIOLOGICAL EFFECTS, *EMBRYO DEVELOPMENT, *FUNDULUS GRANDIS,
0186 ACUTE EFFECTS, BIRDS, OIL SPILLS, CHRONIC EFFECTS, MORTALITY, *DUCKS,
0187 ACUTE EFFECTS, HYDROCARBONS , CRUSTACEANS, *LETHAL THRESHOLDS, *PROCAMBARUS ACUTUS ACUTUS,
R009 ACUTE EFFECTS, FUELS , FISH, TOXICITY, CHRONIC EFFECTS, WSF,
0043 ADSORPTION, CHROMATOGRAPHY, HYDROCARBONS ,
0054 ADSORPTION, SPILL CONTAINMENT, PATENT, *COLLECTING AGENT,
0056 ADSORPTION, SPILL RECOVERY,
0066 ADSORPTION, SPILL CLEANUP, SPILL DISPOSAL, BIODEGRADATION, DISPERSIONS,
0072 ADSORPTION, SPILL CLEANUP, PATENT,
0110 ADSORPTION, WASTEWATER TREATMENT, FUEL OIL, INCINERATION, *ACTIVATED CARBON, *OTTO FUEL,
0118 ADSORPTION, WASTEWATER TREATMENT, PATENT,
0120 ADSORPTION, WASTEWATER TREATMENT, DESIGN-ENGINEERING, PATENT, EQUIPMENT,
0127 ADSORPTION, WASTEWATER TREATMENT, EMULSIONS, PATENT,
0140 ADSORPTION, OIL-WATER SEPARATION, EMULSIONS, PATENT, *SYNTHETIC FIBERS,
R006 ADSORPTION, CRUDE OIL, FOOD WEB, BENTHOS, DISTRIBUTION, PUGET SOUND, *SUSPENDED PARTICLES,
0052 ALASKA, SOURCE IDENTIFICATION, HYDROCARBONS , SEDIMENTS, MARINE ORGANISMS, CHEMICAL ANALYSIS, BENTHOS, *PRUDHOE BAY,
0082 ALASKA, PIPELINES, ECONOMICS, *ACCIDENTS,
0085 ALASKA, OIL TRANSPORT, CRUDE OIL, ENVIRONMENTAL EFFECTS, PIPELINES, TANKERS, WATER QUALITY, US, *WEST COAST,
0086 ALASKA, OIL TRANSPORT, CRUDE OIL, US, ENVIRONMENTAL EFFECTS, EIS,
0204 ALASKA, CRUDE OIL, SEDIMENTS, BACTERIA, INTERTIDAL ZONE, BIOLOGICAL EFFECTS, BIODEGRADATION, *PORT VALDEZ,
0253 ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OCS, BASELINE STUDIES, MONITORING, NOAA, BLM,
0261 ALASKA, ENVIRONMENTAL EFFECTS, BALLAST , WASTEWATERS, PIPELINES, OIL SPILLS, MARINE ORGANISMS, *PORT VALDEZ,
0265 ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, BASELINE STUDIES, OCS, BIOLOGICAL EFFECTS,
0266 ALASKA, ENVIRONMENTAL DETERIORATION, CONSERVATION, OIL INDUSTRY, PIPELINES, OFFSHORE DEVELOPMENT,
0089 ALASKA COAST, BALLAST , PIPELINES, DISPOSAL , *TREATED EFFLUENT,
0188 ALGAE, HYDROCARBONS , SUBLETHAL EFFECTS, BACTERIA, INVERTEBRATES, BEHAVIOR, *CHEMORECEPTION,
0210 ALGAE, FUELS , TOXICITY, *HYDRAZINES, *LUBRICANT ADDITIVES, *JET ENGINE FUELS,
0275 ALGAE, BIODEGRADATION, OIL SHALE, TAR, PLANKTON , BACTERIA,
0019 ANALYTICAL TECHNIQUES, MONITORING, OIL DISCHARGES, WASTEWATERS, SAMPLING, LEGISLATION, UK,
0032 ANALYTICAL TECHNIQUES, SURFACTANTS, EXTRACTION, WASTEWATERS, SEAWATER, FRESHWATER,
0033 ANALYTICAL TECHNIQUES, PAH, SEDIMENTS, LAKES , RIVERS,
0037 ANALYTICAL TECHNIQUES, CHEMICAL ANALYSIS, POLLUTION CONTROL,
0039 ANALYTICAL TECHNIQUES, CONTAMINANTS, PETROLEUM PRODUCTS, ENVIRONMENTAL EFFECTS, TOXICITY,
0042 ANALYTICAL TECHNIQUES, HYDROCARBONS , *CARBON TETRACHLORIDE,
0104 ANALYTICAL TECHNIQUES, MONITORING, WASTEWATER TREATMENT, RESIDUAL OILS, RECYCLING, PATENT, *INFRARED ANALYZER,
0273 ANIMALS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, PLANTS, MARINE ORGANISMS, OCS, ARCTIC, ICE, ENVIRONMENTAL EFFECTS,
0158 API, ENVIRONMENTAL MANAGEMENT, OIL INDUSTRY, ECONOMICS, EPA,
0248 API, COST ANALYSIS, ECONOMICS, OIL INDUSTRY, REFINERIES, POLLUTION CONTROL, *ENVIRONMENTAL EXPENDITURES,
0175 ARCTIC, ACUTE EFFECTS, MARINE ORGANISMS, TOXICITY, SUBARCTIC REGIONS, *BIOASSAYS,

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0205 ARCTIC, HYDROCARBONS , SUBLETHAL EFFECTS, FISH, SUBARCTIC REGIONS,
0240 ARCTIC, BIOLOGICAL EFFECTS, MARINE ORGANISMS, HABITAT, ECOSYSTEMS, SUBARCTIC REGIONS, INTERTIDAL ZONE,
0242 ARCTIC, OFFSHORE EXPLORATION, BIOLOGICAL EFFECTS, BIRDS, MARINE MAMMALS, BEAUFORT SEA,
0246 ARCTIC, TOXICITY, DRILLING , FISH, MORTALITY, *SALMO GAIRDNERI, *DRILLING MUDS,
0256 ARCTIC, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OIL SPILLS, SUBARCTIC REGIONS,
0262 ARCTIC, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS,
0273 ARCTIC, ANIMALS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, PLANTS, MARINE ORGANISMS, OCS, ICE, ENVIRONMENTAL EFFECTS,
0001 ARGO MERCHANT SPILL, DETECTION, MONITORING, LAW ENFORCEMENT, SAMPLING, GOVERNMENT AGENCIES,
0004 ARGO MERCHANT SPILL, STATISTICS, OIL SPILLS, TANKERS,
0008 ARGO MERCHANT SPILL, SANTA BARBARA CHANNEL, EKOFISK BLOWOUT, TORREY CANYON, OIL INDUSTRY, TANKERS, POLLUTION PREVENTION,
0156 ARGO MERCHANT SPILL, POLLUTION CONTROL, TANKERS, SPILL CLEANUP, BEHAVIOR, PERSONNEL TRAINING,
0157 ARGO MERCHANT SPILL, POLLUTION PREVENTION, EQUIPMENT, TANKERS, SPILL CLEANUP, PERSONNEL TRAINING,
0160 ARGO MERCHANT SPILL, SPILL CLEANUP, SPILL RECOVERY, USCG, SOURCE IDENTIFICATION, CONTINGENCY PLANNING,
0194 ARGO MERCHANT SPILL, FISH, MORTALITY, *NANTUCKET SHOALS, *COD, *POLLOCK, *FISH EGGS,
0229 ARGO MERCHANT SPILL, CHESAPEAKE BAY, BIRDS, ECONOMIC EFFECTS, COST ANALYSIS,
0231 ARGO MERCHANT SPILL, MARINE MAMMALS, *NEWFOUNDLAND, *WHALES, *GLOBICEPHALA MELAENA,
0234 ARGO MERCHANT SPILL, FATE, ENVIRONMENTAL EFFECTS, SAMPLING, *WOODS HOLE OCEANOGRAPHIC INSTITUTION,
0161 ATLANTIC COAST, OFFSHORE EXPLORATION, ENVIRONMENTAL MANAGEMENT, ENVIRONMENTAL PROTECTION, MEXICO/GULF OF, OIL DISCHARGES, SAFETY, STATISTICS,
0271 ATLANTIC COAST, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OIL SPILLS, OCS, *RISK ANALYSIS,
0272 ATLANTIC COAST, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OIL SPILLS, OCS, *RISK ANALYSIS,
0302 ATLANTIC OCEAN, TAR, SEAWATER, FATE, DISTRIBUTION, FILTRATION ,
0034 BACTERIA, CHROMATOGRAPHY, PAH, *MICROBIAL TRANSFORMATION,
0188 BACTERIA, ALGAE, HYDROCARBONS , SUBLETHAL EFFECTS, INVERTEBRATES, BEHAVIOR, *CHEMORECEPTION,
0204 BACTERIA, ALASKA, CRUDE OIL, SEDIMENTS, INTERTIDAL ZONE, BIOLOGICAL EFFECTS, BIODEGRADATION, *PORT VALDEZ,
0220 BACTERIA, HYDROCARBONS , CONTAMINATION, BIOLOGICAL EFFECTS, CRUSTACEANS, BIODEGRADATION, BALTIC SEA,
0275 BACTERIA, ALGAE, BIODEGRADATION, OIL SHALE, TAR, PLANKTON ,
0278 BACTERIA, BIODEGRADATION, HYDROCARBONS , OXIDATION, COASTS, JAPAN, *ENUMERATION METHODS,
0281 BACTERIA, BIODEGRADATION, HYDROCARBONS , SEAWATER, USSR, *N-ALKANES,
0084 BALLAST , *COMPUTER SIMULATION SYSTEM, OIL TRANSFER, TANKERS, POLLUTION PREVENTION,
0089 BALLAST , ALASKA COAST, PIPELINES, DISPOSAL , *TREATED EFFLUENT,
0101 BALLAST , OIL TERMINAL, WASTEWATER TREATMENT, EQUIPMENT, NORTH SEA,
0129 BALLAST , WASTEWATER TREATMENT, FLOTATION, OIL-WATER SEPARATION, REFINERIES,
0154 BALLAST , POLLUTION CONTROL, GUIDELINES, OIL DISCHARGES, OIL TERMINAL, BIOLOGICAL EFFECTS, MARINE ORGANISMS, REGULATIONS,
0261 BALLAST , ALASKA, ENVIRONMENTAL EFFECTS, WASTEWATERS, PIPELINES, OIL SPILLS, MARINE ORGANISMS, *PORT VALDEZ,
0220 BALTIC SEA, BACTERIA, HYDROCARBONS , CONTAMINATION, BIOLOGICAL EFFECTS, CRUSTACEANS, BIODEGRADATION,
0253 BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OCS, MONITORING, NOAA, BLM,
0264 BASELINE STUDIES, OFFSHORE EXPLORATION, ENVIRONMENTAL EFFECTS, ICE, BEAUFORT SEA, CANADA,
0265 BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OCS, BIOLOGICAL EFFECTS,
R015 BASELINE STUDIES, OIL TRANSPORT, REFINERIES, ENVIRONMENTAL EFFECTS, HYDROCARBONS , MOVEMENT, MODELS, PUGET SOUND,
R011 BASELINE STUDIES, PLANKTON , DISTRIBUTION, INTERTIDAL ZONE, *STRAIT OF JUAN DE FUCA,
R001 BASELINE STUDIES, SAMPLING, CHEMICAL ANALYSIS, MOLLUSKS, SEDIMENTS, PUGET SOUND,
R004 BASELINE STUDIES, WASTEWATER TREATMENT, REFINERIES, CRUDE OIL, PUGET SOUND,
0002 BEACHES, METULA SPILL, CHRONIC EFFECTS, ESTUARIES, INTERTIDAL ZONE, CHILE,
0203 BEACHES, CRUDE OIL, BIOLOGICAL EFFECTS, *MICE, HEALTH HAZARDS, ISRAEL,
0228 BEACHES, ECONOMIC EFFECTS, LIABILITY, OIL SPILLS, BIRDS, ENVIRONMENTAL EFFECTS, CHESAPEAKE BAY,
0075 BEAUFORT SEA, SPILL CLEANUP, SPILL RECOVERY, ICE, CANADA, *POLAR PACK ICE ,
0242 BEAUFORT SEA, ARCTIC, OFFSHORE EXPLORATION, BIOLOGICAL EFFECTS, BIRDS, MARINE MAMMALS,
0264 BEAUFORT SEA, BASELINE STUDIES, OFFSHORE EXPLORATION, ENVIRONMENTAL EFFECTS, ICE, CANADA,
0028 BEHAVIOR, SAMPLING, FATE, MOVEMENT, SEA SURFACE, MEDITERRANEAN SEA,
0153 BEHAVIOR, POLLUTION CONTROL, MONITORING, SPILL CLEANUP, FATE, BIOLOGICAL EFFECTS, NOAA, *RESEARCH PROGRAMS,

0156 BEHAVIOR, ARGO MERCHANT SPILL, POLLUTION CONTROL, TANKERS, SPILL CLEANUP, PERSONNEL TRAINING,
0166 BEHAVIOR, CHRONIC EFFECTS, OIL SPILLS, MOLLUSKS, CRUSTACEANS, CHEMICAL EFFECTS,
0188 BEHAVIOR, BACTERIA, ALGAE, HYDROCARBONS , SUBLETHAL EFFECTS, INVERTEBRATES, *CHEMORECEPTION,
0223 BEHAVIOR, BLOWOUTS, ICE, MODELS, *ICE SHEET DEFLECTION, *SUBMERGED GAS SOURCE,
0232 BEHAVIOR, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OIL DISCHARGES, PETROLEUM PRODUCTS, *REVIEW,
0298 BEHAVIOR, OIL SLICKS, MODELS,
0052 BENTHOS, ALASKA, SOURCE IDENTIFICATION, HYDROCARBONS , SEDIMENTS, MARINE ORGANISMS, CHEMICAL ANALYSIS, *PRUDHOE BAY,
0209 BENTHOS, FUEL OIL, OIL SPILLS, MARINE ORGANISMS, MORTALITY, BIOLOGICAL EFFECTS, MASSACHUSETTS,
0216 BENTHOS, HYDROCARBONS , CRUSTACEANS, DISTRIBUTION, METABOLISM, *PLESIOPENAEUS EDWARDSIANUS, *N-PARAFFINS,
R006 BENTHOS, ADSORPTION, CRUDE OIL, FOOD WEB, DISTRIBUTION, PUGET SOUND, *SUSPENDED PARTICLES,
R018 BENTHOS, ECOSYSTEMS, FUEL OIL, FATE, BIOLOGICAL EFFECTS, MODELS, PLANKTON ,
R003 BENTHOS, HYDROCARBONS , SEAWATER, SEDIMENT, CHEMICAL ANALYSIS, *TRANSPORT, OIL INDUSTRY, OIL TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
R020 BIBLIOGRAPHIES, RESOURCE MANAGEMENT, POLLUTION CONTROL, OIL INDUSTRY, PUGET SOUND,
0091 BILGES, OIL-WATER SEPARATION, COALESCENCE, POLLUTION CONTROL, PATENT, EQUIPMENT,
0105 BILGES, OIL-WATER SEPARATION, FILTRATION , PATENT, EQUIPMENT,
0030 BIODEGRADATION, SAMPLING, PETROLEUM PRODUCTS, SEAWATER, SEDIMENTS, CHESAPEAKE BAY, *MUTAGENIC SUBSTANCES,
0066 BIODEGRADATION, ADSORPTION, SPILL CLEANUP, SPILL DISPOSAL, DISPERSIONS,
0079 BIODEGRADATION, SPILL CLEANUP, SOURCES, STATISTICAL ANALYSIS, DISPERSIONS, POLLUTION PREVENTION,
0191 BIODEGRADATION, FUEL OIL, BIOLOGICAL EFFECTS, PLANKTON ,
0204 BIODEGRADATION, BACTERIA, ALASKA, CRUDE OIL, SEDIMENTS, INTERTIDAL ZONE, BIOLOGICAL EFFECTS, *PORT VALDEZ,
0220 BIODEGRADATION, BALTIC SEA, BACTERIA, HYDROCARBONS , CONTAMINATION, BIOLOGICAL EFFECTS, CRUSTACEANS,
0237 BIODEGRADATION, OIL SPILLS, TOXICITY, SPILL CLEANUP, *INDUSTRIAL POLLUTANTS,
0275 BIODEGRADATION, BACTERIA, ALGAE, OIL SHALE, TAR, PLANKTON ,
0276 BIODEGRADATION, CRUDE OIL, SEAWATER, *NUTRIENTS, *RESPIROMETRIC METHOD,
0277 BIODEGRADATION, OIL SPILLS, SOIL, DISPOSAL , SLUDGE , *AERATION, *NUTRIENT ADDITION,
0278 BIODEGRADATION, BACTERIA, HYDROCARBONS , OXIDATION, COASTS, JAPAN, *ENUMERATION METHODS,
0279 BIODEGRADATION,PETROLEUM PRODUCTS, HYDROCARBONS , FUNGI, *TRICHODERMA HARZIANUM, *FERRIC HYDROXIDE MUD,
0280 BIODEGRADATION, WASTE OIL DISPOSAL, SOIL, REFINERIES, *SOIL CULTIVATION PROCESS, *LEAD,
0281 BIODEGRADATION, BACTERIA, HYDROCARBONS , SEAWATER, USSR, *N-ALKANES,
0297 BIODEGRADATION, HYDROCARBONS , SEAWATER, SEDIMENTS, WEATHERING, *PHOTOOXIDATION ,
0301 BIODEGRADATION, METULA SPILL, CRUDE OIL, FATE, HYDROCARBONS , MAGELLAN/STRAIT OF,
R016 BIODEGRADATION, CRUDE OIL, MICROORGANISMS, SAMPLING, PUGET SOUND,
0153 BIOLOGICAL EFFECTS, BEHAVIOR, POLLUTION CONTROL, MONITORING, SPILL CLEANUP, FATE, NOAA, *RESEARCH PROGRAMS,
0154 BIOLOGICAL EFFECTS, BALLAST , POLLUTION CONTROL, GUIDELINES, OIL DISCHARGES, OIL TERMINAL, MARINE ORGANISMS, REGULATIONS,
0162 BIOLOGICAL EFFECTS, BIRDS, OIL SPILLS, POLLUTION CONTROL,
0164 BIOLOGICAL EFFECTS, FUEL OIL, MARSHES, CRUSTACEANS, MORTALITY, REPRODUCTION, MASSACHUSETTS,
0172 BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, FRESHWATER, MARSHES, *SPECIES REDUCTION,
0173 BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, FRESHWATER, MARSHES, *SPECIES REDUCTION,
0177 BIOLOGICAL EFFECTS, MICROORGANISMS, FISH,
0178 BIOLOGICAL EFFECTS, ACUTE EFFECTS, FUEL OIL, WSF, HYDROCARBONS , FISH, *EMBRYO DEVELOPMENT, *FUNDULUS GRANDIS,
0179 BIOLOGICAL EFFECTS, DISPERSANTS, CRUSTACEANS, SUBLETHAL EFFECTS, *CRANGON CRANGON,
0180 BIOLOGICAL EFFECTS, CRUDE OIL, MARINE MAMMALS, *PHOCA HISPIDA,
0185 BIOLOGICAL EFFECTS, FISH, INVERTEBRATES, HYDROCARBONS , *DISEASE, *DISEASE RESISTANCE,
0189 BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, OIL DISCHARGES, PLANTS, PLANKTON , MARINE ORGANISMS, NORTH SEA,
0191 BIOLOGICAL EFFECTS, BIODEGRADATION, FUEL OIL, PLANKTON ,
0192 BIOLOGICAL EFFECTS, FUEL OIL, PLANKTON ,
0195 BIOLOGICAL EFFECTS, MARINE ORGANISMS, HYDROCARBONS , SUBLETHAL EFFECTS,
0203 BIOLOGICAL EFFECTS, BEACHES, CRUDE OIL, *MICE, HEALTH HAZARDS, ISRAEL,
0204 BIOLOGICAL EFFECTS, BIODEGRADATION, BACTERIA, ALASKA, CRUDE OIL, SEDIMENTS, INTERTIDAL ZONE, *PORT VALDEZ,
0206 BIOLOGICAL EFFECTS, BIRDS, DISTRIBUTION, HABITAT, CANADA, ST. LAWRENCE RIVER,
0209 BIOLOGICAL EFFECTS, BENTHOS, FUEL OIL, OIL SPILLS, MARINE ORGANISMS, MORTALITY, MASSACHUSETTS,
0218 BIOLOGICAL EFFECTS, CONTAMINANTS, MARINE ORGANISMS, PETROLEUM PRODUCTS, *PHYSIOLOGICAL RESPONSE,

0220 BIOLOGICAL EFFECTS, BIODEGRADATION, BALTIC SEA, BACTERIA, HYDROCARBONS , CONTAMINATION, CRUSTACEANS,
0230 BIOLOGICAL EFFECTS, OIL SPILLS, SOURCES, PETROLEUM PRODUCTS, CRUDE OIL, SLUDGE , FATE,
0232 BIOLOGICAL EFFECTS, BEHAVIOR, ENVIRONMENTAL EFFECTS, OIL DISCHARGES, PETROLEUM PRODUCTS, *REVIEW,
0236 BIOLOGICAL EFFECTS, MARINE ORGANISMS, HYDROCARBONS ,
0240 BIOLOGICAL EFFECTS, ARCTIC, MARINE ORGANISMS, HABITAT, ECOSYSTEMS, SUBARCTIC REGIONS, INTERTIDAL ZONE,
0242 BIOLOGICAL EFFECTS, BEAUFORT SEA, ARCTIC, OFFSHORE EXPLORATION, BIRDS, MARINE MAMMALS,
0243 BIOLOGICAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS, OIL SPILLS, *DRILLING MUD COMPONENTS,
0244 BIOLOGICAL EFFECTS,DRILLING , OFFSHORE PRODUCTION, PLATFORMS, MARINE ORGANISMS, SEDIMENTS, SANTA BARBARA CHANNEL,
0256 BIOLOGICAL EFFECTS, ARCTIC, ENVIRONMENTAL EFFECTS, OIL SPILLS, SUBARCTIC REGIONS,
0265 BIOLOGICAL EFFECTS, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OCS,
0273 BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, OFFSHORE DEVELOPMENT, PLANTS, MARINE ORGANISMS, OCS, ICE, ENVIRONMENTAL EFFECTS,
0274 BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS,
0287 BIOLOGICAL EFFECTS, FUEL OIL, OXIDATION, TOXICITY, YEASTS, *PHOTOOXIDATION ,
0288 BIOLOGICAL EFFECTS, FUEL OIL, OXIDATION, TOXICITY, MARINE ORGANISMS, *PHOTOOXIDATION ,
R018 BIOLOGICAL EFFECTS, BENTHOS, ECOSYSTEMS, FUEL OIL, FATE, MODELS, PLANKTON ,
0117 BIOLOGICAL TREATMENT, WASTEWATER TREATMENT, TAR, WASTE OIL, *RADIAL CLARIFIERS,
0006 BIRDS, OIL SPILLS, STATISTICS, UK, NORTH SEA,
0151 BIRDS, FISH, HABITAT, SPILL CLEANUP,
0162 BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, POLLUTION CONTROL,
0165 BIRDS, OIL SPILLS, SOURCE IDENTIFICATION, MORTALITY, NORTH SEA, ENGLAND,
0174 BIRDS, CONTAMINATION, MORTALITY, UK, *SEABIRDS ,
0186 BIRDS, ACUTE EFFECTS, OIL SPILLS, CHRONIC EFFECTS, MORTALITY, *DUCKS,
0198 BIRDS, CRUDE OIL, *INGESTION, *OSMOREGULATION, *HERRING GULLS,
0206 BIRDS, BIOLOGICAL EFFECTS, DISTRIBUTION, HABITAT, CANADA, ST. LAWRENCE RIVER,
0228 BIRDS, BEACHES, ECONOMIC EFFECTS, LIABILITY, OIL SPILLS, ENVIRONMENTAL EFFECTS, CHESAPEAKE BAY,
0229 BIRDS, ARGO MERCHANT SPILL, CHESAPEAKE BAY, ECONOMIC EFFECTS, COST ANALYSIS,
0242 BIRDS, BIOLOGICAL EFFECTS, BEAUFORT SEA, ARCTIC, OFFSHORE EXPLORATION, MARINE MAMMALS,
R012 BIRDS, HABITAT, OIL SPILLS, DISTRIBUTION, PUGET SOUND,
R014 BIRDS, FUEL OIL, SUBLETHAL EFFECTS, TOXICITY, GUIDELINES,
R010 BIRDS, HYDROCARBONS , TOXICITY, FISH, HEALTH HAZARDS, *ALTERED MEMBRANE,
0221 BLACK SEA, UPTAKE, PAH, CARCINOGENS, FISH, MOLLUSKS,
0253 BLM, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, OCS, MONITORING, NOAA,
0149 BLOWOUT PREVENTION, PERSONNEL TRAINING, *EARLY WARNING TECHNIQUES,
0163 BLOWOUTS, CONTAMINATION, CHRONIC EFFECTS, FISH, OIL SPILLS, NOAA, PETROLEUM PRODUCTS,
0223 BLOWOUTS, BEHAVIOR, ICE, MODELS, *ICE SHEET DEFLECTION, *SUBMERGED GAS SOURCE,
0058 BOOMS, SPILL CONTAINMENT, SHIPS, DESIGN-ENGINEERING, EQUIPMENT,
0060 BOOMS, SPILL RECOVERY, SKIMMERS,
0062 BOOMS, SKIMMERS, SPILL CLEANUP, EQUIPMENT,
0076 BOOMS, OIL SPILLS, SPILL CLEANUP, SKIMMERS, POLLUTION PREVENTION, LEGISLATION,
0023 CALIFORNIA, REMOTE SENSING, NATURAL SEEPAGE, USCG, *RADAR SYSTEMS,
0303 CALIFORNIA, LEGISLATION, US, OIL INDUSTRY, *COASTAL ZONE MANAGEMENT,
0214 CALIFORNIA/SOUTHERN, NATURAL SEEPAGE, CHRONIC EFFECTS, MOLLUSKS, REPRODUCTION, *SIZE,
0009 CANADA, OIL SLICKS, SOURCE IDENTIFICATION,
0075 CANADA, BEAUFORT SEA, SPILL CLEANUP, SPILL RECOVERY, ICE, *POLAR PACK ICE ,
0206 CANADA, BIRDS, BIOLOGICAL EFFECTS, DISTRIBUTION, HABITAT, ST. LAWRENCE RIVER,
0225 CANADA, HYDROCARBONS , CRUDE OIL, SEDIMENTS, *N FIXATION,
0241 CANADA, OIL SPILLS, ENVIRONMENTAL EFFECTS, RESIDUAL OILS, ECONOMIC EFFECTS, *ALEXANDRIA BAY SPILL,
0264 CANADA, BEAUFORT SEA, BASELINE STUDIES, OFFSHORE EXPLORATION, ENVIRONMENTAL EFFECTS, ICE,
0309 CANADA, *FISHING LIMIT, LEGISLATION, SURVEILLANCE, FISHERIES, POLLUTION PREVENTION,
0221 CARCINOGENS, BLACK SEA, UPTAKE, PAH, FISH, MOLLUSKS,
0300 CHEDABUCTO BAY, FUEL OIL, DECOMPOSITION, FATE, *WAVE ENERGY,
0016 CHEMICAL ANALYSIS, MONITORING, SAMPLING, PATENT, DESIGN-ENGINEERING, *REMOTE OPERATION,
0017 CHEMICAL ANALYSIS, MONITORING, HYDROCARBONS , *BOOK REVIEW,
0026 CHEMICAL ANALYSIS, SAMPLING, HYDROCARBONS , SEDIMENTS, CHROMATOGRAPHY, MASSACHUSETTS, *BUZZARDS BAY,
0027 CHEMICAL ANALYSIS, SAMPLING, SEAWATER, PETROLEUM PRODUCTS, *NAGASAKI BAY,
0029 CHEMICAL ANALYSIS, SAMPLING, DETECTION, WSF, CRUDE OIL, FUEL OIL, *METHOD COMPARISON,
0031 CHEMICAL ANALYSIS, CHROMATOGRAPHY, GASOLINE, WSF,
0035 CHEMICAL ANALYSIS, CONTAMINANTS, CHROMATOGRAPHY, *MARKER COMPOUNDS,
0037 CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, POLLUTION CONTROL,
0040 CHEMICAL ANALYSIS, SURFACTANTS, CRUDE OIL, CHROMATOGRAPHY,
0041 CHEMICAL ANALYSIS, CHROMATOGRAPHY, OIL INDUSTRY, PETROCHEMICALS,
0047 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, CRUDE OIL, *TRACE ELEMENTS,

0049 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, FUEL OIL, RESIDUAL OILS, PETROLEUM PRODUCTS, CHROMATOGRAPHY,
0052 CHEMICAL ANALYSIS, BENTHOS, ALASKA, SOURCE IDENTIFICATION, HYDROCARBONS , SEDIMENTS, MARINE ORGANISMS, *PRUDHOE BAY,
0103 CHEMICAL ANALYSIS, WASTEWATERS, REFINERIES, *HEAVY METALS,
0197 CHEMICAL ANALYSIS, FUEL OIL, HYDROCARBONS , DISPERSANTS, TOXICITY, FISH, UPTAKE, *OIL-DISPERSANT MIXTURE,
0224 CHEMICAL ANALYSIS, CHEMICAL EFFECTS, CONTAMINATION,
0227 CHEMICAL ANALYSIS, HYDROCARBONS , TOXICITY, *ALKANES, *CYCLOALKANES, *AROMATICS,
R003 CHEMICAL ANALYSIS, BENTHOS, HYDROCARBONS , SEAWATER, SEDIMENT, *TRANSPORT, OIL INDUSTRY, OIL TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
R001 CHEMICAL ANALYSIS, BASELINE STUDIES, SAMPLING, MOLLUSKS, SEDIMENTS, PUGET SOUND,
0166 CHEMICAL EFFECTS, BEHAVIOR, CHRONIC EFFECTS, OIL SPILLS, MOLLUSKS, CRUSTACEANS,
0224 CHEMICAL EFFECTS, CHEMICAL ANALYSIS, CONTAMINATION,
0226 CHEMICAL EFFECTS, DISPERSION, TOXICITY, SPREADING,
0030 CHESAPEAKE BAY, BIODEGRADATION, SAMPLING, PETROLEUM PRODUCTS, SEAWATER, SEDIMENTS, *MUTAGENIC SUBSTANCES,
0228 CHESAPEAKE BAY, BIRDS, BEACHES, ECONOMIC EFFECTS, LIABILITY, OIL SPILLS, ENVIRONMENTAL EFFECTS,
0229 CHESAPEAKE BAY, BIRDS, ARGO MERCHANT SPILL, ECONOMIC EFFECTS, COST ANALYSIS,
0251 CHESAPEAKE BAY, REFINERIES, ENVIRONMENTAL EFFECTS, EIS, VIRGINIA, *OYSTER BEDS,
0002 CHILE, BEACHES, METULA SPILL, CHRONIC EFFECTS, ESTUARIES, INTERTIDAL ZONE,
0026 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SAMPLING, HYDROCARBONS , SEDIMENTS, MASSACHUSETTS, *BUZZARDS BAY,
0031 CHROMATOGRAPHY, CHEMICAL ANALYSIS, GASOLINE, WSF,
0034 CHROMATOGRAPHY, BACTERIA, PAH, *MICROBIAL TRANSFORMATION,
0035 CHROMATOGRAPHY, CHEMICAL ANALYSIS, CONTAMINANTS, *MARKER COMPOUNDS,
0036 CHROMATOGRAPHY, PETROLEUM PRODUCTS, SOURCE IDENTIFICATION,
0040 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SURFACTANTS, CRUDE OIL,
0041 CHROMATOGRAPHY, CHEMICAL ANALYSIS, OIL INDUSTRY, PETROCHEMICALS,
0043 CHROMATOGRAPHY, ADSORPTION, HYDROCARBONS ,
0044 CHROMATOGRAPHY, HYDROCARBONS , *COAL TAR DISTILLATES,
0049 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, FUEL OIL, RESIDUAL OILS, PETROLEUM PRODUCTS,
0263 CHROMATOGRAPHY, HYDROCARBONS , SOURCES, MARINE ORGANISMS, OFFSHORE PRODUCTION, ENVIRONMENTAL EFFECTS,
0002 CHRONIC EFFECTS, CHILE, BEACHES, METULA SPILL, ESTUARIES, INTERTIDAL ZONE,
0003 CHRONIC EFFECTS, OIL SPILLS, MARINE ORGANISMS, FISHERIES, EKOFISK BLOWOUT,
0152 CHRONIC EFFECTS, SPILL CONTAINMENT, SPILL CLEANUP, ENVIRONMENTAL EFFECTS, EPA, *RESEARCH PROGRAMS,
0163 CHRONIC EFFECTS, BLOWOUTS, CONTAMINATION, FISH, OIL SPILLS, NOAA, PETROLEUM PRODUCTS,
0166 CHRONIC EFFECTS, CHEMICAL EFFECTS, BEHAVIOR, OIL SPILLS, MOLLUSKS, CRUSTACEANS,
0186 CHRONIC EFFECTS, BIRDS, ACUTE EFFECTS, OIL SPILLS, MORTALITY, *DUCKS,
0207 CHRONIC EFFECTS, FUEL OIL, CONTAMINATION, TOXICITY, FISH, MARSHES, *BIOCHEMICAL CHANGES,
0213 CHRONIC EFFECTS, HYDROCARBONS , TOXICITY, MARINE ORGANISMS, SUBLETHAL EFFECTS, UPTAKE, RELEASE,
0214 CHRONIC EFFECTS, CALIFORNIA/SOUTHERN, NATURAL SEEPAGE, MOLLUSKS, REPRODUCTION, *SIZE,
0235 CHRONIC EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, SPILL CLEANUP, SURFACTANTS,
R009 CHRONIC EFFECTS, ACUTE EFFECTS, FUELS , FISH, TOXICITY, WSF,
0091 COALESCENCE, BILGES, OIL-WATER SEPARATION, POLLUTION CONTROL, PATENT, EQUIPMENT,
0145 COALESCENCE, OIL-WATER SEPARATION, GRAVITY SEPARATION, DESIGN-ENGINEERING, PATENT, EQUIPMENT,
0146 COALESCENCE, OIL-WATER SEPARATION,
0012 COASTS, MONITORING, DETECTION, REMOTE SENSING, LAKES , BAYS, RIVERS, USCG, *CONTINUOUS WAVE LASER,
0155 COASTS, POLLUTION PREVENTION, *SYMPOSIUM,
0278 COASTS, BIODEGRADATION, BACTERIA, HYDROCARBONS , OXIDATION, JAPAN, *ENUMERATION METHODS,
R008 COASTS, MARINE MAMMALS, DISTRIBUTION, PUGET SOUND, *HARBOR SEAL,
0306 COMPENSATION, LIABILITY, OIL SPILLS, INTERNATIONAL CONVENTIONS, SPILL CLEANUP, *OIL SPILL FUND,
0266 CONSERVATION, ALASKA, ENVIRONMENTAL DETERIORATION, OIL INDUSTRY, PIPELINES, OFFSHORE DEVELOPMENT,
0022 CONTAMINANTS, REMOTE SENSING, OIL SPILLS, MONITORING, ENVIRONMENTAL EFFECTS,
0035 CONTAMINANTS, CHROMATOGRAPHY, CHEMICAL ANALYSIS, *MARKER COMPOUNDS,
0039 CONTAMINANTS, ANALYTICAL TECHNIQUES, PETROLEUM PRODUCTS, ENVIRONMENTAL EFFECTS, TOXICITY,
0218 CONTAMINANTS, BIOLOGICAL EFFECTS, MARINE ORGANISMS, PETROLEUM PRODUCTS, *PHYSIOLOGICAL RESPONSE,
0282 CONTAMINANTS, MODELS, SPREADING, OCEANS,
R002 CONTAMINANTS, SAMPLING, WASTEWATERS, MICROORGANISMS, *PRESERVATION,
0051 CONTAMINATION, SOURCE IDENTIFICATION, TANKERS, PLATFORMS, OIL TERMINAL, OFFSHORE PRODUCTION, OIL DISCHARGES, NORTH SEA,
0081 CONTAMINATION, RESTORATION, SOIL, CRUDE OIL, MICROORGANISMS, DECOMPOSITION, *NIGERIA,

0093 CONTAMINATION, WASTEWATER TREATMENT, REFINERIES, SURFACTANTS, USSR, *DEMULSIFIER,
0163 CONTAMINATION, CHRONIC EFFECTS, BLOWOUTS, FISH, OIL SPILLS, NOAA, PETROLEUM PRODUCTS,
0168 CONTAMINATION, PETROLEUM PRODUCTS, SUBLETHAL EFFECTS, MORTALITY, CRUSTACEANS, *HOMARUS AMERICANUS,
0174 CONTAMINATION, BIRDS, MORTALITY, UK, *SEABIRDS ,
0207 CONTAMINATION, CHRONIC EFFECTS, FUEL OIL, TOXICITY, FISH, MARSHES, *BIOCHEMICAL CHANGES,
0220 CONTAMINATION, BIOLOGICAL EFFECTS, BIODEGRADATION, BALTIC SEA, BACTERIA, HYDROCARBONS CRUSTACEANS,
0224 CONTAMINATION, CHEMICAL EFFECTS, CHEMICAL ANALYSIS,
0239 CONTAMINATION, ENVIRONMENTAL DETERIORATION, MEDITERRANEAN SEA,
0257 CONTAMINATION, GROUNDWATER, DRILLING , OIL WELLS, *DRILLING FLUIDS, *WELL COMPLETION,
R013 CONTAMINATION, FISH, INVERTEBRATES, DISTRIBUTION, FOOD WEB, *POLLUTANT PATHWAYS, *STRAIT OF JUAN DE FUCA,
0010 CONTINGENCY PLANNING, EKOFISK BLOWOUT, SPILL CONTAINMENT, SPILL CLEANUP,
0067 CONTINGENCY PLANNING, SPILL CLEANUP, MODELS, OFFSHORE DEVELOPMENT, GEORGES BANK, MASSACHUSETTS,
0080 CONTINGENCY PLANNING, SPILL CLEANUP, US, POLLUTION PREVENTION,
0150 CONTINGENCY PLANNING, EQUIPMENT, EKOFISK BLOWOUT, SPILL CLEANUP, DESIGN-ENGINEERING, NORWAY, NORTH SEA,
0160 CONTINGENCY PLANNING, ARGO MERCHANT SPILL, SPILL CLEANUP, SPILL RECOVERY, USCG, SOURCE IDENTIFICATION,
0311 CONTINGENCY PLANNING, INTERNATIONAL CONVENTIONS, POLLUTION CONTROL,
R005 CONTINGENCY PLANNING, MODELS, ENVIRONMENTAL EFFECTS, RESOURCE MANAGEMENT,
R019 CONTINGENCY PLANNING, MODELS, POLLUTION PREVENTION, PUGET SOUND,
0088 COST ANALYSIS, REFINERIES, WASTEWATER TREATMENT, ECONOMICS, WATER QUALITY,
0109 COST ANALYSIS, WASTEWATER TREATMENT, SOLID WASTES, INDUSTRIES, POLLUTION CONTROL,
0124 COST ANALYSIS, DRILLING , WASTEWATER TREATMENT, SLUDGE , DISPOSAL ,
0229 COST ANALYSIS, CHESAPEAKE BAY, BIRDS, ARGO MERCHANT SPILL, ECONOMIC EFFECTS,
0248 COST ANALYSIS, API, ECONOMICS, OIL INDUSTRY, REFINERIES, POLLUTION CONTROL, *ENVIRONMENTAL EXPENDITURES,
0290 COST ANALYSIS, OIL SPILLS, FATE, MODELS, NORTH SEA, EKOFISK BLOWOUT, *SLIKTRAK PROGRAM,
0029 CRUDE OIL, CHEMICAL ANALYSIS, SAMPLING, DETECTION, WSF, FUEL OIL, *METHOD COMPARISON,
0038 CRUDE OIL, SOURCE IDENTIFICATION, SPECTROSCOPY, FUEL OIL, PETROLEUM PRODUCTS,
0040 CRUDE OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SURFACTANTS,
0047 CRUDE OIL, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, *TRACE ELEMENTS,
0048 CRUDE OIL, SOURCE IDENTIFICATION, SPECTROSCOPY, STATISTICAL ANALYSIS, WEATHERING,
0081 CRUDE OIL, CONTAMINATION, RESTORATION, SOIL, MICROORGANISMS, DECOMPOSITION, *NIGERIA,
0085 CRUDE OIL, ALASKA, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, PIPELINES, TANKERS, WATER QUALITY, US, *WEST COAST,
0086 CRUDE OIL, ALASKA, OIL TRANSPORT, US, ENVIRONMENTAL EFFECTS, EIS,
0115 CRUDE OIL, RESIDUAL OILS, WASTE OIL DISPOSAL, TANKERS, OIL TANKS, POLLUTION PREVENTION,
0116 CRUDE OIL, OIL TANKS, SLUDGE , PATENT, *SLUDGE REMOVAL,
0135 CRUDE OIL, OIL-WATER SEPARATION, ENVIRONMENTAL EFFECTS, OIL DISCHARGES, WASTEWATER TREATMENT, UK, NORTH SEA,
0167 CRUDE OIL, MORTALITY, SUBLETHAL EFFECTS, FISH, HYDROCARBONS , WSF, FUEL OIL, *HATCHING SUCCESS,
0169 CRUDE OIL, FUEL OIL, HYDROCARBONS , METABOLISM, CRUSTACEANS, MOLLUSKS, MARINE ORGANISMS,
0180 CRUDE OIL, BIOLOGICAL EFFECTS, MARINE MAMMALS, *PHOCA HISPIDA,
0182 CRUDE OIL, HYDROCARBONS , FISH, SUBLETHAL EFFECTS, *COHO SALMON,
0198 CRUDE OIL, BIRDS, *INGESTION, *OSMOREGULATION, *HERRING GULLS,
0203 CRUDE OIL, BIOLOGICAL EFFECTS, BEACHES, *MICE, HEALTH HAZARDS, ISRAEL,
0204 CRUDE OIL, BIOLOGICAL EFFECTS, BIODEGRADATION, BACTERIA, ALASKA, SEDIMENTS, INTERTIDAL ZONE, *PORT VALDEZ,
0225 CRUDE OIL, CANADA, HYDROCARBONS , SEDIMENTS, *N FIXATION,
0230 CRUDE OIL, BIOLOGICAL EFFECTS, OIL SPILLS, SOURCES, PETROLEUM PRODUCTS, SLUDGE , FATE,
0276 CRUDE OIL, BIODEGRADATION, SEAWATER, *NUTRIENTS, *RESPIROMETRIC METHOD,
0289 CRUDE OIL, EKOFISK BLOWOUT, DRIFT, OIL SLICKS,
0301 CRUDE OIL, BIODEGRADATION, METULA SPILL, FATE, HYDROCARBONS , MAGELLAN/STRAIT OF,
R016 CRUDE OIL, BIODEGRADATION, MICROORGANISMS, SAMPLING, PUGET SOUND,
R006 CRUDE OIL, BENTHOS, ADSORPTION, FOOD WEB, DISTRIBUTION, PUGET SOUND, *SUSPENDED PARTICLES,
R004 CRUDE OIL, BASELINE STUDIES, WASTEWATER TREATMENT, REFINERIES, PUGET SOUND,
0164 CRUSTACEANS, BIOLOGICAL EFFECTS, FUEL OIL, MARSHES, MORTALITY, REPRODUCTION, MASSACHUSETTS,
0166 CRUSTACEANS, CHRONIC EFFECTS, CHEMICAL EFFECTS, BEHAVIOR, OIL SPILLS, MOLLUSKS,
0168 CRUSTACEANS, CONTAMINATION, PETROLEUM PRODUCTS, SUBLETHAL EFFECTS, MORTALITY, *HOMARUS AMERICANUS,
0169 CRUSTACEANS, CRUDE OIL, FUEL OIL, HYDROCARBONS , METABOLISM, MOLLUSKS, MARINE ORGANISMS,
0179 CRUSTACEANS, BIOLOGICAL EFFECTS, DISPERSANTS, SUBLETHAL EFFECTS, *CRANGON CRANGON,
0187 CRUSTACEANS, ACUTE EFFECTS, HYDROCARBONS , *LETHAL THRESHOLDS, *PROCAMBARUS ACUTUS ACUTUS,
0193 CRUSTACEANS, PETROLEUM PRODUCTS, WASTE OIL, TOXICITY, INTERTIDAL ZONE, *LABORATORY CULTURES,

0201 CRUSTACEANS, HYDROCARBONS , PETROLEUM PRODUCTS, TOXICITY, *BALANUS,
0208 CRUSTACEANS, HYDROCARBONS , TOXICITY, METABOLISM, *NAPHTHALENE, *LARVAE,
0212 CRUSTACEANS, SURFACTANTS, TOXICITY, DISTRIBUTION, UK, *CLIBANARIUS ERYTHROPUS,
0216 CRUSTACEANS, BENTHOS, HYDROCARBONS , DISTRIBUTION, METABOLISM, *PLESIOPENAEUS EDWARDSIANUS, *N-PARAFFINS,
0220 CRUSTACEANS, CONTAMINATION, BIOLOGICAL EFFECTS, BIODEGRADATION, BALTIC SEA, BACTERIA, HYDROCARBONS ,
0081 DECOMPOSITION, CRUDE OIL, CONTAMINATION, RESTORATION, SOIL, MICROORGANISMS, *NIGERIA,
0300 DECOMPOSITION, CHEDABUCTO BAY, FUEL OIL, FATE, *WAVE ENERGY,
0292 DELAWARE, HYDROCARBONS , FATE, SEDIMENTATION, ESTUARIES, RESTORATION, *CORINTHOS OIL SPILL,
0016 DESIGN-ENGINEERING, CHEMICAL ANALYSIS, MONITORING, SAMPLING, PATENT, *REMOTE OPERATION,
0018 DESIGN-ENGINEERING, MONITORING, DETECTION, OIL SPILLS, EQUIPMENT, PATENT, *ALARM DEVICE,
0055 DESIGN-ENGINEERING, SPILL CLEANUP, SPILL RECOVERY,
0058 DESIGN-ENGINEERING, BOOMS, SPILL CONTAINMENT, SHIPS, EQUIPMENT,
0120 DESIGN-ENGINEERING, ADSORPTION, WASTEWATER TREATMENT, PATENT, EQUIPMENT,
0133 DESIGN-ENGINEERING, OIL-WATER SEPARATION, WASTEWATER TREATMENT, GRAVITY SEPARATION, EQUIPMENT,
0138 DESIGN-ENGINEERING, OIL-WATER SEPARATION, REFINERIES, OFFSHORE PRODUCTION, WASTEWATER TREATMENT, DISPOSAL , ENVIRONMENTAL EFFECTS, MONITORING,
0145 DESIGN-ENGINEERING, COALESCENCE, OIL-WATER SEPARATION, GRAVITY SEPARATION, PATENT, EQUIPMENT,
0150 DESIGN-ENGINEERING, CONTINGENCY PLANNING, EQUIPMENT, EKOFISK BLOWOUT, SPILL CLEANUP, NORWAY, NORTH SEA,
0293 DESIGN-ENGINEERING, OIL SLICKS, MONITORING, DRIFT, *TRACKING BUOY,
0001 DETECTION, ARGO MERCHANT SPILL, MONITORING, LAW ENFORCEMENT, SAMPLING, GOVERNMENT AGENCIES,
0012 DETECTION, COASTS, MONITORING, REMOTE SENSING, LAKES , BAYS, RIVERS, USCG, *CONTINUOUS WAVE LASER,
0013 DETECTION, MONITORING, PETROLEUM PRODUCTS, OIL SPILLS, EQUIPMENT, *OIL SENSOR,
0018 DETECTION, DESIGN-ENGINEERING, MONITORING, OIL SPILLS, EQUIPMENT, PATENT, *ALARM DEVICE,
0020 DETECTION, MONITORING, EQUIPMENT, RECLAMATION, SAMPLING,
0021 DETECTION, MONITORING, OIL SLICKS, SURVEILLANCE, *OIL-ON-WATER,
0029 DETECTION, CRUDE OIL, CHEMICAL ANALYSIS, SAMPLING, WSF, FUEL OIL, *METHOD COMPARISON,
0126 DETECTION, ABSORPTION, WASTEWATER TREATMENT, REFINERIES, *ACTIVATED CARBON,
0183 DEVELOPMENT , TOXICITY, FISH, *STARRED STURGEON, *DEEMULSIFIERS , *GROWTH,
0077 DISPERSANTS, SPILL CLEANUP, OIL SLICKS, PATENT, *RESIN,
0179 DISPERSANTS, CRUSTACEANS, BIOLOGICAL EFFECTS, SUBLETHAL EFFECTS, *CRANGON CRANGON,
0190 DISPERSANTS, FUELS , LUBRICATING OIL, ZOOPLANKTON, TOXICITY,
0197 DISPERSANTS, CHEMICAL ANALYSIS, FUEL OIL, HYDROCARBONS , TOXICITY, FISH, UPTAKE, *OIL-DISPERSANT MIXTURE,
0066 DISPERSIONS, BIODEGRADATION, ADSORPTION, SPILL CLEANUP, SPILL DISPOSAL,
0079 DISPERSIONS, BIODEGRADATION, SPILL CLEANUP, SOURCES, STATISTICAL ANALYSIS, POLLUTION PREVENTION,
0100 DISPERSIONS, HYDROCARBONS , *OXYGEN TRANSFER, *INDUSTRIAL FERMENTATIONS,
0141 DISPERSIONS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOTATION, EMULSIONS, PATENT,
0226 DISPERSIONS, CHEMICAL EFFECTS, TOXICITY, SPREADING.
0089 DISPOSAL , BALLAST , ALASKA COAST, PIPELINES, *TREATED EFFLUENT,
0107 DISPOSAL , WASTEWATER TREATMENT, DRILLING , *MUD SOLIDIFICATION PROCESS,
0113 DISPOSAL , WASTEWATERS, OFFSHORE DRILLING, POLLUTION PREVENTION, *OILY DRILL CUTTINGS,
0114 DISPOSAL , DRILLING , SOLID WASTES, *OIL BASE DRILLING MUDS, *DRILL CUTTINGS,
0121 DISPOSAL , DRILLING , TOXICITY, OIL INDUSTRY, GUIDELINES, WASTEWATERS, *DRILLING FLUIDS,
0124 DISPOSAL , COST ANALYSIS, DRILLING , WASTEWATER TREATMENT, SLUDGE ,
0138 DISPOSAL , DESIGN-ENGINEERING, OIL-WATER SEPARATION, REFINERIES, OFFSHORE PRODUCTION, WASTEWATER TREATMENT, ENVIRONMENTAL EFFECTS, MONITORING,
0277 DISPOSAL , BIODEGRADATION, OIL SPILLS, SOIL, SLUDGE , *AERATION, *NUTRIENT ADDITION,
0206 DISTRIBUTION, CANADA, BIRDS, BIOLOGICAL EFFECTS, HABITAT, ST. LAWRENCE RIVER,
0212 DISTRIBUTION, CRUSTACEANS, SURFACTANTS, TOXICITY, UK, *CLIBANARIUS ERYTHROPUS,
0216 DISTRIBUTION, CRUSTACEANS, BENTHOS, HYDROCARBONS , METABOLISM, *PLESIOPENAEUS EDWARDSIANUS, *N-PARAFFINS,
0295 DISTRIBUTION, HYDROCARBONS , SEAWATER, SEDIMENTS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS,
0302 DISTRIBUTION, ATLANTIC OCEAN, TAR, SEAWATER, FATE, FILTRATION ,
R012 DISTRIBUTION, BIRDS, HABITAT, OIL SPILLS, PUGET SOUND,
R006 DISTRIBUTION, CRUDE OIL, BENTHOS, ADSORPTION, FOOD WEB, PUGET SOUND, *SUSPENDED PARTICLES,
R013 DISTRIBUTION, CONTAMINATION, FISH, INVERTEBRATES, FOOD WEB, *POLLUTANT PATHWAYS, *STRAIT OF JUAN DE FUCA,
R008 DISTRIBUTION, COASTS, MARINE MAMMALS, PUGET SOUND, *HARBOR SEAL,
R011 DISTRIBUTION, BASELINE STUDIES, PLANKTON , INTERTIDAL ZONE, *STRAIT OF JUAN DE FUCA,
0014 DRIFT, MONITORING, OIL SLICKS, MOVEMENT, EQUIPMENT, *BUOY,

0284 DRIFT, OIL SLICKS, OCEANS, POLLUTION CONTROL, *DRIFT VELOCITY, *WIND, *WAVES,
0289 DRIFT, CRUDE OIL, EKOFISK BLOWOUT, OIL SLICKS,
0293 DRIFT, DESIGN-ENGINEERING, OIL SLICKS, MONITORING, *TRACKING BUOY,
R017 DRIFT, OIL SLICKS, MONITORING, PUGET SOUND, *AERIAL DROGUE STUDY, *PREDICTION,
0107 DRILLING , DISPOSAL , WASTEWATER TREATMENT, *MUD SOLIDIFICATION PROCESS,
0114 DRILLING , DISPOSAL , SOLID WASTES, *OIL BASE DRILLING MUDS, *DRILL CUTTINGS,
0121 DRILLING , DISPOSAL , TOXICITY, OIL INDUSTRY, GUIDELINES, WASTEWATERS, *DRILLING FLUIDS,
0123 DRILLING , WASTE OIL DISPOSAL, OIL FIELDS, REGULATIONS, STATE GOVERNMENTS, TEXAS,
0124 DRILLING , DISPOSAL , COST ANALYSIS, WASTEWATER TREATMENT, SLUDGE ,
0245 DRILLING , TOXICITY, PLANTS, *GROWTH, *DRILLING FLUID COMPONENTS,
0246 DRILLING , ARCTIC, TOXICITY, FISH, MORTALITY, *SALMO GAIRDNERI, *DRILLING MUDS,
0247 DRILLING , OIL WELLS, TOXICITY, ENVIRONMENTAL EFFECTS, FISH, *SALMON, *DRILLING MUDS,
0255 DRILLING , TOXICITY, MARINE ORGANISMS, *SHRIMP, *DRILLING FLUID ADDITIVES,
0257 DRILLING , CONTAMINATION, GROUNDWATER, OIL WELLS, *DRILLING FLUIDS, *WELL COMPLETION,
0228 ECONOMIC EFFECTS, CHESAPEAKE BAY, BIRDS, BEACHES, LIABILITY, OIL SPILLS, ENVIRONMENTAL EFFECTS,
0229 ECONOMIC EFFECTS, COST ANALYSIS, CHESAPEAKE BAY, BIRDS, ARGO MERCHANT SPILL,
0241 ECONOMIC EFFECTS, CANADA, OIL SPILLS, ENVIRONMENTAL EFFECTS, RESIDUAL OILS, *ALEXANDRIA BAY SPILL,
0258 ECONOMIC EFFECTS, OFFSHORE EXPLORATION, OFFSHORE DEVELOPMENT, OIL INDUSTRY, FISHERIES, GEORGES BANK,
0269 ECONOMIC EFFECTS, PORTS, ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, ONSHORE IMPACTS, LOUISIANA, *SUPERPORT,
0082 ECONOMICS, ALASKA, PIPELINES, *ACCIDENTS,
0088 ECONOMICS, COST ANALYSIS, REFINERIES, WASTEWATER TREATMENT, WATER QUALITY,
0158 ECONOMICS, API, ENVIRONMENTAL MANAGEMENT, OIL INDUSTRY, EPA,
0248 ECONOMICS, COST ANALYSIS, API, OIL INDUSTRY, REFINERIES, POLLUTION CONTROL, *ENVIRONMENTAL EXPENDITURES,
0252 ECONOMICS, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ONSHORE IMPACTS, REGULATIONS, OIL-GAS LEASING,
0308 ECONOMICS, INTERNATIONAL CONVENTIONS, POLLUTION CONTROL, MONITORING, MEDITERRANEAN SEA, UN, *UNEP,
0240 ECOSYSTEMS, BIOLOGICAL EFFECTS, ARCTIC, MARINE ORGANISMS, HABITAT, SUBARCTIC REGIONS, INTERTIDAL ZONE,
R018 ECOSYSTEMS, BIOLOGICAL EFFECTS, BENTHOS, FUEL OIL, FATE, MODELS, PLANKTON ,
0086 EIS, CRUDE OIL, ALASKA, OIL TRANSPORT, US, ENVIRONMENTAL EFFECTS,
0251 EIS, CHESAPEAKE BAY, REFINERIES, ENVIRONMENTAL EFFECTS, VIRGINIA, *OYSTER BEDS,
0003 EKOFISK BLOWOUT, CHRONIC EFFECTS, OIL SPILLS, MARINE ORGANISMS, FISHERIES,
0008 EKOFISK BLOWOUT, ARGO MERCHANT SPILL, SANTA BARBARA CHANNEL, TORREY CANYON, OIL INDUSTRY, TANKERS, POLLUTION PREVENTION,
0010 EKOFISK BLOWOUT, CONTINGENCY PLANNING, SPILL CONTAINMENT, SPILL CLEANUP,
0150 EKOFISK BLOWOUT, DESIGN-ENGINEERING, CONTINGENCY PLANNING, EQUIPMENT, SPILL CLEANUP, NORWAY, NORTH SEA,
0289 EKOFISK BLOWOUT, DRIFT, CRUDE OIL, OIL SLICKS,
0290 EKOFISK BLOWOUT, COST ANALYSIS, OIL SPILLS, FATE, MODELS, NORTH SEA, *SLIKTRAK PROGRAM,
0095 EMULSIONS, WASTEWATER TREATMENT, INCINERATION, FUEL OIL, PATENT,
0111 EMULSIONS, FLOCCULATION, OIL-WATER SEPARATION, PATENT,
0125 EMULSIONS, WASTEWATER TREATMENT, PATENT, *SULFURIC ACID PITCH,
0127 EMULSIONS, ADSORPTION, WASTEWATER TREATMENT, PATENT,
0128 EMULSIONS, WASTEWATER TREATMENT, SURFACTANTS, PATENT,
0134 EMULSIONS, OIL-WATER SEPARATION, FLOTATION, SURFACTANTS, SEAWATER,
0136 EMULSIONS, OIL-WATER SEPARATION, PETROLEUM PRODUCTS, FUELS , LUBRICATING OIL, HYDROCARBONS , *AERATION,
0140 EMULSIONS, ADSORPTION, OIL-WATER SEPARATION, PATENT, *SYNTHETIC FIBERS,
0141 EMULSIONS, DISPERSIONS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOTATION, PATENT,
0144 EMULSIONS, OIL-WATER SEPARATION, PATENT, EQUIPMENT,
0069 ENGLAND, SPILL CLEANUP, POLLUTION CONTROL, *SURFACE FILM-FORMING CHEMICALS,
0165 ENGLAND, BIRDS, OIL SPILLS, SOURCE IDENTIFICATION, MORTALITY, NORTH SEA,
0239 ENVIRONMENTAL DETERIORATION, CONTAMINATION, MEDITERRANEAN SEA,
0266 ENVIRONMENTAL DETERIORATION, CONSERVATION, ALASKA, OIL INDUSTRY, PIPELINES, OFFSHORE DEVELOPMENT,
0022 ENVIRONMENTAL EFFECTS, CONTAMINANTS, REMOTE SENSING, OIL SPILLS, MONITORING,
0039 ENVIRONMENTAL EFFECTS, CONTAMINANTS, ANALYTICAL TECHNIQUES, PETROLEUM PRODUCTS TOXICITY,
0085 ENVIRONMENTAL EFFECTS, CRUDE OIL, ALASKA, OIL TRANSPORT, PIPELINES, TANKERS, WATER QUALITY, US, *WEST COAST,
0086 ENVIRONMENTAL EFFECTS, EIS, CRUDE OIL, ALASKA, OIL TRANSPORT, US,
0135 ENVIRONMENTAL EFFECTS, CRUDE OIL, OIL-WATER SEPARATION, OIL DISCHARGES, WASTEWATER TREATMENT, UK, NORTH SEA,
0138 ENVIRONMENTAL EFFECTS, DISPOSAL , DESIGN-ENGINEERING, OIL-WATER SEPARATION, REFINERIES, OFFSHORE PRODUCTION, WASTEWATER TREATMENT, MONITORING,
0152 ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, SPILL CONTAINMENT, SPILL CLEANUP, EPA, *RESEARCH PROGRAMS,
0228 ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CHESAPEAKE BAY, BIRDS, BEACHES, LIABILITY, OIL SPILLS,

0232 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BEHAVIOR, OIL DISCHARGES, PETROLEUM PRODUCTS, *REVIEW,
0234 ENVIRONMENTAL EFFECTS, ARGO MERCHANT SPILL, FATE, SAMPLING, *WOODS HOLE OCEANOGRAPHIC INSTITUTION,
0235 ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, OIL SPILLS, SPILL CLEANUP, SURFACTANTS,
0238 ENVIRONMENTAL EFFECTS, *REVIEW,
0241 ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CANADA, OIL SPILLS, RESIDUAL OILS, *ALEXANDRIA BAY SPILL,
0247 ENVIRONMENTAL EFFECTS, DRILLING , OIL WELLS, TOXICITY, FISH, *SALMON, *DRILLING MUDS,
0249 ENVIRONMENTAL EFFECTS, STORAGE, OFFSHORE DEVELOPMENT, FEA, FISHERIES, MEXICO/GULF OF, *SHRIMP, *SALT DOMES,
0251 ENVIRONMENTAL EFFECTS, EIS, CHESAPEAKE BAY, REFINERIES, VIRGINIA, *OYSTER BEDS,
0252 ENVIRONMENTAL EFFECTS, ECONOMICS, OFFSHORE DEVELOPMENT, ONSHORE IMPACTS, REGULATIONS, OIL-GAS LEASING,
0253 ENVIRONMENTAL EFFECTS, BLM, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, OCS, MONITORING, NOAA,
0254 ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, POLLUTION CONTROL, NORTH SEA, NORWAY,
0256 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, OIL SPILLS, SUBARCTIC REGIONS,
0259 ENVIRONMENTAL EFFECTS, TAR SANDS, PRODUCTION , EXTRACTION,
0261 ENVIRONMENTAL EFFECTS, BALLAST , ALASKA, WASTEWATERS, PIPELINES, OIL SPILLS, MARINE ORGANISMS, *PORT VALDEZ,
0262 ENVIRONMENTAL EFFECTS, ARCTIC, OFFSHORE DEVELOPMENT,
0263 ENVIRONMENTAL EFFECTS, CHROMATOGRAPHY, HYDROCARBONS , SOURCES, MARINE ORGANISMS, OFFSHORE PRODUCTION,
0264 ENVIRONMENTAL EFFECTS, CANADA, BEAUFORT SEA, BASELINE STUDIES, OFFSHORE EXPLORATION, ICE,
0265 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, OCS,
0267 ENVIRONMENTAL EFFECTS, OFFSHORE EXPLORATION, OFFSHORE PRODUCTION, OIL SPILLS, LEGISLATION, ONSHORE IMPACTS,
0268 ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING, PLATFORMS, MARINE ORGANISMS, *DRILLING DISCHARGES,
0269 ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, PORTS, OFFSHORE DEVELOPMENT, ONSHORE IMPACTS, LOUISIANA, *SUPERPORT,
0270 ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, OIL INDUSTRY, MEXICO/GULF OF,
0271 ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DEVELOPMENT, OIL SPILLS, OCS, *RISK ANALYSIS,
0272 ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DEVELOPMENT, OIL SPILLS, OCS, *RISK ANALYSIS,
0273 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, OFFSHORE DEVELOPMENT, PLANTS, MARINE ORGANISMS, OCS, ICE,
0274 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING, MARINE ORGANISMS,
0295 ENVIRONMENTAL EFFECTS, DISTRIBUTION, HYDROCARBONS , SEAWATER, SEDIMENTS, MARINE ORGANISMS,
R005 ENVIRONMENTAL EFFECTS, CONTINGENCY PLANNING, MODELS, RESOURCE MANAGEMENT,
R015 ENVIRONMENTAL EFFECTS, BASELINE STUDIES, OIL TRANSPORT, REFINERIES, HYDROCARBONS , MOVEMENT, MODELS, PUGET SOUND,
0158 ENVIRONMENTAL MANAGEMENT, ECONOMICS, API, OIL INDUSTRY, EPA,
0161 ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, OFFSHORE EXPLORATION, ENVIRONMENTAL PROTECTION, MEXICO/GULF OF, OIL DISCHARGES, SAFETY, STATISTICS,
0098 ENVIRONMENTAL PROTECTION, REFINERIES, POLLUTION PREVENTION, EQUIPMENT,
0119 ENVIRONMENTAL PROTECTION, OCS, OIL DISCHARGES, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, REGULATIONS, NORTH SEA,
0147 ENVIRONMENTAL PROTECTION, RECYCLING, WASTE OIL, MODELS, LEGISLATION,
0161 ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, OFFSHORE EXPLORATION, MEXICO/GULF OF, OIL DISCHARGES, SAFETY, STATISTICS,
0250 ENVIRONMENTAL PROTECTION, OFFSHORE DEVELOPMENT, OIL-GAS LEASING, REGULATIONS, US GOVERNMENT, STATE GOVERNMENTS,
0025 EPA, REMOTE SENSING, OIL SPILLS, SPILL CLEANUP, *REMOTE SENSING SYSTEMS,
0152 EPA, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, SPILL CONTAINMENT, SPILL CLEANUP, *RESEARCH PROGRAMS,
0158 EPA, ENVIRONMENTAL MANAGEMENT, ECONOMICS, API, OIL INDUSTRY,
0310 EPA, LEGISLATION, GUIDELINES, WATER QUALITY, INDUSTRIES, US, *EFFLUENT LIMITATIONS,
0013 EQUIPMENT, DETECTION, MONITORING, PETROLEUM PRODUCTS, OIL SPILLS, *OIL SENSOR,
0014 EQUIPMENT, DRIFT, MONITORING, OIL SLICKS, MOVEMENT, *BUOY,
0018 EQUIPMENT, DETECTION, DESIGN-ENGINEERING, MONITORING, OIL SPILLS, PATENT, *ALARM DEVICE,
0020 EQUIPMENT, DETECTION, MONITORING, RECLAMATION, SAMPLING,
0057 EQUIPMENT, SPILL CLEANUP, SPILL RECOVERY, SKIMMERS,
0058 EQUIPMENT, DESIGN-ENGINEERING, BOOMS, SPILL CONTAINMENT, SHIPS,
0062 EQUIPMENT, BOOMS, SKIMMERS, SPILL CLEANUP,
0063 EQUIPMENT, SKIMMERS, SPILL RECOVERY,
0065 EQUIPMENT, SPILL CONTAINMENT, MODELS, *STREAMING-FIBER SYSTEM,
0070 EQUIPMENT, SPILL CLEANUP, POLLUTION PREVENTION, OIL-WATER SEPARATION, INDUSTRIES,

0074 EQUIPMENT, SPILL CLEANUP, SPILL RECOVERY, SANTA BARBARA CHANNEL, *SUBMERGED CANOPIES,
0091 EQUIPMENT, COALESCENCE, BILGES, OIL-WATER SEPARATION, POLLUTION CONTROL, PATENT,
0098 EQUIPMENT, ENVIRONMENTAL PROTECTION, REFINERIES, POLLUTION PREVENTION,
0101 EQUIPMENT, BALLAST , OIL TERMINAL, WASTEWATER TREATMENT, NORTH SEA,
0105 EQUIPMENT, BILGES, OIL-WATER SEPARATION, FILTRATION , PATENT,
0120 EQUIPMENT, DESIGN-ENGINEERING, ADSORPTION, WASTEWATER TREATMENT, PATENT,
0132 EQUIPMENT, OIL-WATER SEPARATION, OIL SPILLS, HYDROCARBONS , GRAVITY SEPARATION,
0133 EQUIPMENT, DESIGN-ENGINEERING, OIL-WATER SEPARATION, WASTEWATER TREATMENT, GRAVITY SEPARATION,
0139 EQUIPMENT, OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT, FILTRATION , GRAVITY SEPARATION, FLOTATION,
0142 EQUIPMENT, OIL-WATER SEPARATION, PATENT, *ELECTROSTATIC SEPARATION,
0144 EQUIPMENT, EMULSIONS, OIL-WATER SEPARATION, PATENT,
0145 EQUIPMENT, DESIGN-ENGINEERING, COALESCENCE, OIL-WATER SEPARATION, GRAVITY SEPARATION, PATENT,
0150 EQUIPMENT, EKOFISK BLOWOUT, DESIGN-ENGINEERING, CONTINGENCY PLANNING, SPILL CLEANUP, NORWAY, NORTH SEA,
0157 EQUIPMENT, ARGO MERCHANT SPILL, POLLUTION PREVENTION, TANKERS, SPILL CLEANUP, PERSONNEL TRAINING,
0002 ESTUARIES, CHRONIC EFFECTS, CHILE, BEACHES, METULA SPILL, INTERTIDAL ZONE,
0292 ESTUARIES, DELAWARE, HYDROCARBONS , FATE, SEDIMENTATION, RESTORATION, *CORINTHOS OIL SPILL,
0286 EVAPORATION, OIL SPILLS, WEATHERING, MODELS,
0032 EXTRACTION, ANALYTICAL TECHNIQUES, SURFACTANTS, WASTEWATERS, SEAWATER, FRESHWATER,
0259 EXTRACTION, ENVIRONMENTAL EFFECTS, TAR SANDS, PRODUCTION ,
0028 FATE, BEHAVIOR, SAMPLING, MOVEMENT, SEA SURFACE, MEDITERRANEAN SEA,
0153 FATE, BIOLOGICAL EFFECTS, BEHAVIOR, POLLUTION CONTROL, MONITORING, SPILL CLEANUP, NOAA, *RESEARCH PROGRAMS,
0230 FATE, CRUDE OIL, BIOLOGICAL EFFECTS, OIL SPILLS, SOURCES, PETROLEUM PRODUCTS, SLUDGE ,
0234 FATE, ENVIRONMENTAL EFFECTS, ARGO MERCHANT SPILL, SAMPLING, *WOODS HOLE OCEANOGRAPHIC INSTITUTION,
0290 FATE, EKOFISK BLOWOUT, COST ANALYSIS, OIL SPILLS, MODELS, NORTH SEA, *SLIKTRAK PROGRAM,
0292 FATE, ESTUARIES, DELAWARE, HYDROCARBONS , SEDIMENTATION, RESTORATION, *CORINTHOS OIL SPILL,
0296 FATE, HYDROCARBONS , WEATHERING, OCEANS, *POLLUTANT TRANSFER,
0299 FATE, ICE, MOVEMENT, OFFSHORE DEVELOPMENT, *OIL-IN-ICE ,
0300 FATE, DECOMPOSITION, CHEDABUCTO BAY, FUEL OIL, *WAVE ENERGY,
0301 FATE, CRUDE OIL, BIODEGRADATION, METULA SPILL, HYDROCARBONS , MAGELLAN/STRAIT OF,
0302 FATE, DISTRIBUTION, ATLANTIC OCEAN, TAR, SEAWATER, FILTRATION ,
R018 FATE, ECOSYSTEMS, BIOLOGICAL EFFECTS, BENTHOS, FUEL OIL, MODELS, PLANKTON ,
0249 FEA, ENVIRONMENTAL EFFECTS, STORAGE, OFFSHORE DEVELOPMENT, FISHERIES, MEXICO/GULF OF, *SHRIMP, *SALT DOMES,
0105 FILTRATION , EQUIPMENT, BILGES, OIL-WATER SEPARATION, PATENT,
0137 FILTRATION , OIL-WATER SEPARATION, WASTEWATER TREATMENT, PATENT,
0139 FILTRATION , EQUIPMENT, OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT, GRAVITY SEPARATION, FLOTATION,
0302 FILTRATION , FATE, DISTRIBUTION, ATLANTIC OCEAN, TAR, SEAWATER,
0151 FISH, BIRDS, HABITAT, SPILL CLEANUP,
0163 FISH, CONTAMINATION, CHRONIC EFFECTS, BLOWOUTS, OIL SPILLS, NOAA, PETROLEUM PRODUCTS,
0167 FISH, CRUDE OIL, MORTALITY, SUBLETHAL EFFECTS, HYDROCARBONS , WSF, FUEL OIL, *HATCHING SUCCESS,
0177 FISH, BIOLOGICAL EFFECTS, MICROORGANISMS,
0178 FISH, BIOLOGICAL EFFECTS, ACUTE EFFECTS, FUEL OIL, WSF, HYDROCARBONS , *EMBRYO DEVELOPMENT, *FUNDULUS GRANDIS,
0182 FISH, CRUDE OIL, HYDROCARBONS , SUBLETHAL EFFECTS, *COHO SALMON,
0183 FISH, DEVELOPMENT , TOXICITY, *STARRED STURGEON, *DEEMULSIFIERS , *GROWTH,
0185 FISH, BIOLOGICAL EFFECTS, INVERTEBRATES, HYDROCARBONS , *DISEASE, *DISEASE RESISTANCE,
0194 FISH, ARGO MERCHANT SPILL, MORTALITY, *NANTUCKET SHOALS, *COD, *POLLOCK, *FISH EGGS,
0197 FISH, DISPERSANTS, CHEMICAL ANALYSIS, FUEL OIL, HYDROCARBONS , TOXICITY, UPTAKE, *OIL-DISPERSANT MIXTURE,
0205 FISH, ARCTIC, HYDROCARBONS , SUBLETHAL EFFECTS, SUBARCTIC REGIONS,
0207 FISH, CONTAMINATION, CHRONIC EFFECTS, FUEL OIL, TOXICITY, MARSHES, *BIOCHEMICAL CHANGES,
0211 FISH, TOXICITY, METABOLISM, *DEEMULSIFIERS , *CARP ORGANS, *MORPHOLOGICAL CHANGES,
0219 FISH, TOXICITY, FUEL OIL, *ARIUS FELIS,
0221 FISH, CARCINOGENS, BLACK SEA, UPTAKE, PAH, MOLLUSKS,
0246 FISH, DRILLING , ARCTIC, TOXICITY, MORTALITY, *SALMO GAIRDNERI, *DRILLING MUDS,
0247 FISH, ENVIRONMENTAL EFFECTS, DRILLING , OIL WELLS, TOXICITY, *SALMON, *DRILLING MUDS,
R013 FISH, DISTRIBUTION, CONTAMINATION, INVERTEBRATES, FOOD WEB, *POLLUTANT PATHWAYS, *STRAIT OF JUAN DE FUCA,
R009 FISH, CHRONIC EFFECTS, ACUTE EFFECTS, FUELS , TOXICITY, WSF,
R010 FISH, BIRDS, HYDROCARBONS , TOXICITY, HEALTH HAZARDS, *ALTERED MEMBRANE,
0003 FISHERIES, EKOFISK BLOWOUT, CHRONIC EFFECTS, OIL SPILLS, MARINE ORGANISMS,
0202 FISHERIES, HYDROCARBONS , *NAPHTHALENES, *MAXIMUM PERMISSIBLE CONCENTRATION,
0249 FISHERIES, FEA, ENVIRONMENTAL EFFECTS, STORAGE, OFFSHORE DEVELOPMENT, MEXICO/GULF OF, *SHRIMP, *SALT DOMES,

0258 FISHERIES, ECONOMIC EFFECTS, OFFSHORE EXPLORATION, OFFSHORE DEVELOPMENT, OIL INDUSTRY, GEORGES BANK,
0309 FISHERIES, CANADA, *FISHING LIMIT, LEGISLATION, SURVEILLANCE, POLLUTION PREVENTION,
0108 FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, FLOTATION, *COAGULATION,
0111 FLOCCULATION, EMULSIONS, OIL-WATER SEPARATION, PATENT,
0131 FLOCCULATION, ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES, PETROCHEMICALS, FLOTATION,
0106 FLOTATION, WASTEWATER TREATMENT, PETROLEUM PRODUCTS,
0108 FLOTATION, FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, *COAGULATION,
0129 FLOTATION, BALLAST , WASTEWATER TREATMENT, OIL-WATER SEPARATION, REFINERIES,
0131 FLOTATION, FLOCCULATION, ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES, PETROCHEMICALS,
0134 FLOTATION, EMULSIONS, OIL-WATER SEPARATION, SURFACTANTS, SEAWATER,
0139 FLOTATION, FILTRATION , EQUIPMENT, OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT, GRAVITY SEPARATION,
0141 FLOTATION, EMULSIONS, DISPERSIONS, OIL-WATER SEPARATION, WASTEWATER TREATMENT, PATENT,
R006 FOOD WEB, DISTRIBUTION, CRUDE OIL, BENTHOS, ADSORPTION, PUGET SOUND, *SUSPENDED PARTICLES,
R013 FOOD WEB, FISH, DISTRIBUTION, CONTAMINATION, INVERTEBRATES, *POLLUTANT PATHWAYS, *STRAIT OF JUAN DE FUCA,
0032 FRESHWATER, EXTRACTION, ANALYTICAL TECHNIQUES, SURFACTANTS, WASTEWATERS, SEAWATER,
0172 FRESHWATER, BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, MARSHES, *SPECIES REDUCTION,
0173 FRESHWATER, BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, MARSHES, *SPECIES REDUCTION,
0029 FUEL OIL, DETECTION, CRUDE OIL, CHEMICAL ANALYSIS, SAMPLING, WSF, *METHOD COMPARISON,
0038 FUEL OIL, CRUDE OIL, SOURCE IDENTIFICATION, SPECTROSCOPY, PETROLEUM PRODUCTS,
0049 FUEL OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, RESIDUAL OILS, PETROLEUM PRODUCTS,
0092 FUEL OIL, WASTE OIL TREATMENT, INCINERATION, PATENT,
0095 FUEL OIL, EMULSIONS, WASTEWATER TREATMENT, INCINERATION, PATENT,
0110 FUEL OIL, ADSORPTION, WASTEWATER TREATMENT, INCINERATION, *ACTIVATED CARBON, *OTTO FUEL,
0164 FUEL OIL, CRUSTACEANS, BIOLOGICAL EFFECTS, MARSHES, MORTALITY, REPRODUCTION, MASSACHUSETTS,
0167 FUEL OIL, FISH, CRUDE OIL, MORTALITY, SUBLETHAL EFFECTS, HYDROCARBONS , WSF, *HATCHING SUCCESS,
0169 FUEL OIL, CRUSTACEANS, CRUDE OIL, HYDROCARBONS , METABOLISM, MOLLUSKS, MARINE ORGANISMS,
0178 FUEL OIL, FISH, BIOLOGICAL EFFECTS, ACUTE EFFECTS, WSF, HYDROCARBONS , *EMBRYO DEVELOPMENT, *FUNDULUS GRANDIS,
0184 FUEL OIL, OIL SPILLS, MARSHES, RESTORATION, SEDIMENTS, MASSACHUSETTS, *MARSH GRASS,
0191 FUEL OIL, BIOLOGICAL EFFECTS, BIODEGRADATION, PLANKTON ,
0192 FUEL OIL, BIOLOGICAL EFFECTS, PLANKTON ,
0197 FUEL OIL, FISH, DISPERSANTS, CHEMICAL ANALYSIS, HYDROCARBONS , TOXICITY, UPTAKE, *OIL-DISPERSANT MIXTURE,
0207 FUEL OIL, FISH, CONTAMINATION, CHRONIC EFFECTS, TOXICITY, MARSHES, *BIOCHEMICAL CHANGES,
0209 FUEL OIL, BIOLOGICAL EFFECTS, BENTHOS, OIL SPILLS, MARINE ORGANISMS, MORTALITY, MASSACHUSETTS,
0215 FUEL OIL, PAH, TOXICITY, WASTEWATER TREATMENT, LAKES , *SALAMANDERS, *DIESEL OIL, *ASPHALT,
0219 FUEL OIL, FISH, TOXICITY, *ARIUS FELIS,
0287 FUEL OIL, BIOLOGICAL EFFECTS, OXIDATION, TOXICITY. YEASTS, *PHOTOOXIDATION ,
0288 FUEL OIL, BIOLOGICAL EFFECTS, OXIDATION, TOXICITY, MARINE ORGANISMS, *PHOTOOXIDATION ,
0300 FUEL OIL, FATE, DECOMPOSITION, CHEDABUCTO BAY, *WAVE ENERGY,
R018 FUEL OIL, FATE, ECOSYSTEMS, BIOLOGICAL EFFECTS, BENTHOS, MODELS, PLANKTON ,
R014 FUEL OIL, BIRDS, SUBLETHAL EFFECTS, TOXICITY, GUIDELINES,
0136 FUELS , EMULSIONS, OIL-WATER SEPARATION, PETROLEUM PRODUCTS, LUBRICATING OIL, HYDROCARBONS , *AERATION,
0190 FUELS , DISPERSANTS, LUBRICATING OIL, ZOOPLANKTON, TOXICITY,
0210 FUELS , ALGAE, TOXICITY, *HYDRAZINES, *LUBRICANT ADDITIVES, *JET ENGINE FUELS,
R009 FUELS , FISH, CHRONIC EFFECTS, ACUTE EFFECTS, TOXICITY, WSF,
0279 FUNGI, BIODEGRADATION,PETROLEUM PRODUCTS, HYDROCARBONS , *TRICHODERMA HARZIANUM, *FERRIC HYDROXIDE MUD,
0031 GASOLINE, CHROMATOGRAPHY, CHEMICAL ANALYSIS, WSF,
0170 GASOLINE, TOXICITY, AROMATIC HYDROCARBONS, *AEDES AEGYPTI,
0067 GEORGES BANK, CONTINGENCY PLANNING, SPILL CLEANUP, MODELS, OFFSHORE DEVELOPMENT, MASSACHUSETTS,
0258 GEORGES BANK, FISHERIES, ECONOMIC EFFECTS, OFFSHORE EXPLORATION, OFFSHORE DEVELOPMENT, OIL INDUSTRY,
0001 GOVERNMENT AGENCIES, DETECTION, ARGO MERCHANT SPILL, MONITORING, LAW ENFORCEMENT, SAMPLING,
0094 GRAVITY SEPARATION, PRODUCTION , REFINERIES, OIL-WATER SEPARATION, *OIL INTERCEPTORS,

0132 GRAVITY SEPARATION, EQUIPMENT, OIL-WATER SEPARATION, OIL SPILLS, HYDROCARBONS ,
0133 GRAVITY SEPARATION, EQUIPMENT, DESIGN-ENGINEERING, OIL-WATER SEPARATION, WASTEWATER TREATMENT,
0139 GRAVITY SEPARATION, FLOTATION, FILTRATION , EQUIPMENT, OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT,
0143 GRAVITY SEPARATION, OIL-WATER SEPARATION, SPILL CLEANUP, PATENT,
0145 GRAVITY SEPARATION, EQUIPMENT, DESIGN-ENGINEERING, COALESCENCE, OIL-WATER SEPARATION, PATENT,
0257 GROUNDWATER, DRILLING , CONTAMINATION, OIL WELLS, *DRILLING FLUIDS, *WELL COMPLETION,
0121 GUIDELINES, DRILLING , DISPOSAL , TOXICITY, OIL INDUSTRY, WASTEWATERS, *DRILLING FLUIDS,
0154 GUIDELINES, BIOLOGICAL EFFECTS, BALLAST , POLLUTION CONTROL, OIL DISCHARGES, OIL TERMINAL, MARINE ORGANISMS, REGULATIONS,
0310 GUIDELINES, EPA, LEGISLATION, WATER QUALITY, INDUSTRIES, US, *EFFLUENT LIMITATIONS,
R014 GUIDELINES, FUEL OIL, BIRDS, SUBLETHAL EFFECTS, TOXICITY,
0151 HABITAT, FISH, BIRDS, SPILL CLEANUP,
0206 HABITAT, DISTRIBUTION, CANADA, BIRDS, BIOLOGICAL EFFECTS, ST. LAWRENCE RIVER,
0240 HABITAT, ECOSYSTEMS, BIOLOGICAL EFFECTS, ARCTIC, MARINE ORGANISMS, SUBARCTIC REGIONS, INTERTIDAL ZONE,
R012 HABITAT, DISTRIBUTION, BIRDS, OIL SPILLS, PUGET SOUND,
0285 HARBORS, MOVEMENT, SEDIMENTATION, INDUSTRIES, MASSACHUSETTS, *NEW BEDFORD HARBOR,
0203 HEALTH HAZARDS, CRUDE OIL, BIOLOGICAL EFFECTS, BEACHES, *MICE, ISRAEL,
R010 HEALTH HAZARDS, FISH, BIRDS, HYDROCARBONS , TOXICITY, *ALTERED MEMBRANE,
0015 HYDROCARBONS , MONITORING, OCEANS, MEXICO/GULF OF, OFFSHORE PRODUCTION,
0017 HYDROCARBONS , CHEMICAL ANALYSIS, MONITORING, *BOOK REVIEW,
0026 HYDROCARBONS , CHROMATOGRAPHY, CHEMICAL ANALYSIS, SAMPLING, SEDIMENTS, MASSACHUSETTS, *BUZZARDS BAY,
0042 HYDROCARBONS , ANALYTICAL TECHNIQUES, *CARBON TETRACHLORIDE,
0043 HYDROCARBONS , CHROMATOGRAPHY, ADSORPTION,
0044 HYDROCARBONS , CHROMATOGRAPHY, *COAL TAR DISTILLATES,
0045 HYDROCARBONS , SOURCE IDENTIFICATION, PRODUCTION , MEXICO/GULF OF, MISSISSIPPI RIVER,
0052 HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, ALASKA, SOURCE IDENTIFICATION, SEDIMENTS, MARINE ORGANISMS, *PRUDHOE BAY,
0100 HYDROCARBONS , DISPERSIONS, *OXYGEN TRANSFER, *INDUSTRIAL FERMENTATIONS,
0132 HYDROCARBONS , GRAVITY SEPARATION, EQUIPMENT, OIL-WATER SEPARATION, OIL SPILLS,
0136 HYDROCARBONS , FUELS , EMULSIONS, OIL-WATER SEPARATION, PETROLEUM PRODUCTS, LUBRICATING OIL, *AERATION,
0167 HYDROCARBONS , FUEL OIL, FISH, CRUDE OIL, MORTALITY, SUBLETHAL EFFECTS, WSF, *HATCHING SUCCESS,
0169 HYDROCARBONS , FUEL OIL, CRUSTACEANS, CRUDE OIL, METABOLISM, MOLLUSKS, MARINE ORGANISMS,
0178 HYDROCARBONS , FUEL OIL, FISH, BIOLOGICAL EFFECTS, ACUTE EFFECTS, WSF, *EMBRYO DEVELOPMENT, *FUNDULUS GRANDIS,
0181 HYDROCARBONS , TOXICITY, MOLLUSKS, SEDIMENTS, *CARBON FLUX, *MYA ARENARIA,
0182 HYDROCARBONS , FISH, CRUDE OIL, SUBLETHAL EFFECTS, *COHO SALMON,
0185 HYDROCARBONS , FISH, BIOLOGICAL EFFECTS, INVERTEBRATES, *DISEASE, *DISEASE RESISTANCE,
0187 HYDROCARBONS , CRUSTACEANS, ACUTE EFFECTS, *LETHAL THRESHOLDS, *PROCAMBARUS ACUTUS ACUTUS,
0188 HYDROCARBONS , BEHAVIOR, BACTERIA, ALGAE, SUBLETHAL EFFECTS, INVERTEBRATES, *CHEMORECEPTION,
0195 HYDROCARBONS , BIOLOGICAL EFFECTS, MARINE ORGANISMS, SUBLETHAL EFFECTS,
0196 HYDROCARBONS , TOXICITY, MOLLUSKS, RESPIRATION, *MYTILUS EDULIS,
0197 HYDROCARBONS , FUEL OIL, FISH, DISPERSANTS, CHEMICAL ANALYSIS, TOXICITY, UPTAKE, *OIL-DISPERSANT MIXTURE,
0199 HYDROCARBONS , UPTAKE, MICROORGANISMS, *ADHESION,
0200 HYDROCARBONS , UPTAKE, MICROORGANISMS, *GROWTH KINETICS,
0201 HYDROCARBONS , CRUSTACEANS, PETROLEUM PRODUCTS, TOXICITY, *BALANUS,
0202 HYDROCARBONS , FISHERIES, *NAPHTHALENES, *MAXIMUM PERMISSIBLE CONCENTRATION,
0205 HYDROCARBONS , FISH, ARCTIC, SUBLETHAL EFFECTS, SUBARCTIC REGIONS,
0208 HYDROCARBONS , CRUSTACEANS, TOXICITY, METABOLISM, *NAPHTHALENE, *LARVAE,
0213 HYDROCARBONS , CHRONIC EFFECTS, TOXICITY, MARINE ORGANISMS, SUBLETHAL EFFECTS, UPTAKE, RELEASE,
0216 HYDROCARBONS , DISTRIBUTION, CRUSTACEANS, BENTHOS, METABOLISM, *PLESIOPENAEUS EDWARDSIANUS, *N-PARAFFINS,
0217 HYDROCARBONS , UPTAKE, METABOLISM, RELEASE, MARINE ORGANISMS, SUBLETHAL EFFECTS, *BIOCHEMICAL CHANGES,
0220 HYDROCARBONS , CRUSTACEANS, CONTAMINATION, BIOLOGICAL EFFECTS, BIODEGRADATION, BALTIC SEA, BACTERIA,
0225 HYDROCARBONS , CRUDE OIL, CANADA, SEDIMENTS, *N FIXATION,
0227 HYDROCARBONS , CHEMICAL ANALYSIS, TOXICITY, *ALKANES, *CYCLOALKANES, *AROMATICS,
0236 HYDROCARBONS , BIOLOGICAL EFFECTS, MARINE ORGANISMS,
0263 HYDROCARBONS , ENVIRONMENTAL EFFECTS, CHROMATOGRAPHY, SOURCES, MARINE ORGANISMS, OFFSHORE PRODUCTION,
0278 HYDROCARBONS , COASTS, BIODEGRADATION, BACTERIA, OXIDATION, JAPAN, *ENUMERATION METHODS,

0279 HYDROCARBONS , FUNGI, BIODEGRADATION,PETROLEUM PRODUCTS, *TRICHODERMA HARZIANUM, *FERRIC HYDROXIDE MUD,
0281 HYDROCARBONS , BIODEGRADATION, BACTERIA, SEAWATER, USSR, *N-ALKANES,
0292 HYDROCARBONS , FATE, ESTUARIES, DELAWARE, SEDIMENTATION, RESTORATION, *CORINTHOS OIL SPILL,
0295 HYDROCARBONS , ENVIRONMENTAL EFFECTS, DISTRIBUTION, SEAWATER, SEDIMENTS, MARINE ORGANISMS,
0296 HYDROCARBONS , FATE, WEATHERING, OCEANS, *POLLUTANT TRANSFER,
0297 HYDROCARBONS , BIODEGRADATION, SEAWATER, SEDIMENTS, WEATHERING, *PHOTOOXIDATION ,
0301 HYDROCARBONS , FATE, CRUDE OIL, BIODEGRADATION, METULA SPILL, MAGELLAN/STRAIT OF,
R003 HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEAWATER, SEDIMENT, *TRANSPORT, OIL INDUSTRY, OIL TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
R010 HYDROCARBONS , HEALTH HAZARDS, FISH, BIRDS, TOXICITY, *ALTERED MEMBRANE,
R007 HYDROCARBONS , INSECTS, *PLEUSTON, *BIO-INDICATOR, *HALOBATES,
R015 HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES, OIL TRANSPORT, REFINERIES, MOVEMENT, MODELS, PUGET SOUND,
0005 ICE, OIL SPILLS, *HUDSON RIVER,
0075 ICE, CANADA, BEAUFORT SEA, SPILL CLEANUP, SPILL RECOVERY, *POLAR PACK ICE ,
0223 ICE, BLOWOUTS, BEHAVIOR, MODELS, *ICE SHEET DEFLECTION, *SUBMERGED GAS SOURCE,
0264 ICE, ENVIRONMENTAL EFFECTS, CANADA, BEAUFORT SEA, BASELINE STUDIES, OFFSHORE EXPLORATION,
0273 ICE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, OFFSHORE DEVELOPMENT, PLANTS, MARINE ORGANISMS, OCS,
0299 ICE, FATE, MOVEMENT, OFFSHORE DEVELOPMENT, *OIL-IN-ICE ,
0092 INCINERATION, FUEL OIL, WASTE OIL TREATMENT, PATENT,
0095 INCINERATION, FUEL OIL, EMULSIONS, WASTEWATER TREATMENT, PATENT,
0096 INCINERATION, WASTEWATER TREATMENT, SLUDGE , REFINERIES, USSR, *WATER PURIFICATION,
0110 INCINERATION, FUEL OIL, ADSORPTION, WASTEWATER TREATMENT, *ACTIVATED CARBON, *OTTO FUEL,
0070 INDUSTRIES, EQUIPMENT, SPILL CLEANUP, POLLUTION PREVENTION, OIL-WATER SEPARATION,
0099 INDUSTRIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, WASTE OIL TREATMENT, *TREATMENT PROCESSES,
0109 INDUSTRIES, COST ANALYSIS, WASTEWATER TREATMENT, SOLID WASTES, POLLUTION CONTROL,
0285 INDUSTRIES, HARBORS, MOVEMENT, SEDIMENTATION, MASSACHUSETTS, *NEW BEDFORD HARBOR,
0310 INDUSTRIES, GUIDELINES, EPA, LEGISLATION, WATER QUALITY, US, *EFFLUENT LIMITATIONS,
0007 INFORMATION SYSTEMS, OIL SPILLS, SOURCES, *SPILL DIRECTORY,
0307 INTERNATIONAL AGREEMENTS, LEGISLATION, POLLUTION CONTROL, MEDITERRANEAN SEA, *UN CONFERENCE/LAW OF THE SEA,
0306 INTERNATIONAL CONVENTIONS, COMPENSATION, LIABILITY, OIL SPILLS, SPILL CLEANUP, *OIL SPILL FUND,
0308 INTERNATIONAL CONVENTIONS, ECONOMICS, POLLUTION CONTROL, MONITORING, MEDITERRANEAN SEA, UN, *UNEP,
0311 INTERNATIONAL CONVENTIONS, CONTINGENCY PLANNING, POLLUTION CONTROL,
0002 INTERTIDAL ZONE, ESTUARIES, CHRONIC EFFECTS, CHILE, BEACHES, METULA SPILL,
0193 INTERTIDAL ZONE, CRUSTACEANS, PETROLEUM PRODUCTS, WASTE OIL, TOXICITY, *LABORATORY CULTURES,
0204 INTERTIDAL ZONE, CRUDE OIL, BIOLOGICAL EFFECTS, BIODEGRADATION, BACTERIA, ALASKA, SEDIMENTS, *PORT VALDEZ,
0240 INTERTIDAL ZONE, HABITAT, ECOSYSTEMS, BIOLOGICAL EFFECTS, ARCTIC, MARINE ORGANISMS, SUBARCTIC REGIONS,
R011 INTERTIDAL ZONE, DISTRIBUTION, BASELINE STUDIES, PLANKTON , *STRAIT OF JUAN DE FUCA,
0185 INVERTEBRATES, HYDROCARBONS , FISH, BIOLOGICAL EFFECTS, *DISEASE, *DISEASE RESISTANCE,
0188 INVERTEBRATES, HYDROCARBONS , BEHAVIOR, BACTERIA, ALGAE, SUBLETHAL EFFECTS, *CHEMORECEPTION,
R013 INVERTEBRATES, FOOD WEB, FISH, DISTRIBUTION, CONTAMINATION, *POLLUTANT PATHWAYS, *STRAIT OF JUAN DE FUCA,
0203 ISRAEL, HEALTH HAZARDS, CRUDE OIL, BIOLOGICAL EFFECTS, BEACHES, *MICE,
0278 JAPAN, HYDROCARBONS , COASTS, BIODEGRADATION, BACTERIA, OXIDATION, *ENUMERATION METHODS,
0012 LAKES , DETECTION, COASTS, MONITORING, REMOTE SENSING, BAYS, RIVERS, USCG, *CONTINUOUS WAVE LASER,
0033 LAKES , ANALYTICAL TECHNIQUES, PAH, SEDIMENTS, RIVERS,
0215 LAKES , FUEL OIL, PAH, TOXICITY, WASTEWATER TREATMENT, *SALAMANDERS, *DIESEL OIL, *ASPHALT,
0001 LAW ENFORCEMENT, GOVERNMENT AGENCIES, DETECTION, ARGO MERCHANT SPILL, MONITORING, SAMPLING,
0083 LEAKAGE, SPILL CONTAINMENT, OIL TRANSFER, POLLUTION PREVENTION, PORTS, *CONTAINMENT RING,
0087 LEAKAGE, OIL SPILLS, TANKERS, STATISTICS, OIL TRANSPORT, US,
0019 LEGISLATION, ANALYTICAL TECHNIQUES, MONITORING, OIL DISCHARGES, WASTEWATERS, SAMPLING, UK,
0076 LEGISLATION, BOOMS, OIL SPILLS, SPILL CLEANUP, SKIMMERS, POLLUTION PREVENTION,
0147 LEGISLATION, ENVIRONMENTAL PROTECTION, RECYCLING, WASTE OIL, MODELS,
0267 LEGISLATION, ENVIRONMENTAL EFFECTS, OFFSHORE EXPLORATION, OFFSHORE PRODUCTION, OIL SPILLS, ONSHORE IMPACTS,

0303 LEGISLATION, CALIFORNIA, US, OIL INDUSTRY, *COASTAL ZONE MANAGEMENT,
0307 LEGISLATION, INTERNATIONAL AGREEMENTS, POLLUTION CONTROL, MEDITERRANEAN SEA, *UN CONFERENCE/LAW OF THE SEA,
0309 LEGISLATION, FISHERIES, CANADA, *FISHING LIMIT, SURVEILLANCE, POLLUTION PREVENTION,
0310 LEGISLATION, INDUSTRIES, GUIDELINES, EPA, WATER QUALITY, US, *EFFLUENT LIMITATIONS,
0228 LIABILITY, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CHESAPEAKE BAY, BIRDS, BEACHES, OIL SPILLS,
0306 LIABILITY, INTERNATIONAL CONVENTIONS, COMPENSATION, OIL SPILLS, SPILL CLEANUP, *OIL SPILL FUND,
0269 LOUISIANA, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, PORTS, OFFSHORE DEVELOPMENT, ONSHORE IMPACTS, *SUPERPORT,
0136 LUBRICATING OIL, HYDROCARBONS , FUELS , EMULSIONS, OIL-WATER SEPARATION, PETROLEUM PRODUCTS, *AERATION,
0148 LUBRICATING OIL, WASTE OIL, RECLAMATION,
0190 LUBRICATING OIL, FUELS , DISPERSANTS, ZOOPLANKTON, TOXICITY,
0301 MAGELLAN/STRAIT OF, HYDROCARBONS , FATE, CRUDE OIL, BIODEGRADATION, METULA SPILL,
0180 MARINE MAMMALS, CRUDE OIL, BIOLOGICAL EFFECTS, *PHOCA HISPIDA,
0231 MARINE MAMMALS, ARGO MERCHANT SPILL, *NEWFOUNDLAND, *WHALES, *GLOBICEPHALA MELAENA,
0242 MARINE MAMMALS, BIRDS, BIOLOGICAL EFFECTS, BEAUFORT SEA, ARCTIC, OFFSHORE EXPLORATION,
R008 MARINE MAMMALS, DISTRIBUTION, COASTS, PUGET SOUND, *HARBOR SEAL,
0003 MARINE ORGANISMS, FISHERIES, EKOFISK BLOWOUT, CHRONIC EFFECTS, OIL SPILLS,
0052 MARINE ORGANISMS, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, ALASKA, SOURCE IDENTIFICATION, SEDIMENTS, *PRUDHOE BAY,
0154 MARINE ORGANISMS, GUIDELINES, BIOLOGICAL EFFECTS, BALLAST , POLLUTION CONTROL, OIL DISCHARGES, OIL TERMINAL, REGULATIONS,
0169 MARINE ORGANISMS, HYDROCARBONS , FUEL OIL, CRUSTACEANS, CRUDE OIL, METABOLISM, MOLLUSKS,
0175 MARINE ORGANISMS, ARCTIC, ACUTE EFFECTS, TOXICITY, SUBARCTIC REGIONS, *BIOASSAYS,
0189 MARINE ORGANISMS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, OIL DISCHARGES, PLANTS, PLANKTON , NORTH SEA,
0195 MARINE ORGANISMS, HYDROCARBONS , BIOLOGICAL EFFECTS, SUBLETHAL EFFECTS,
0209 MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, BENTHOS, OIL SPILLS, MORTALITY, MASSACHUSETTS,
0213 MARINE ORGANISMS, HYDROCARBONS , CHRONIC EFFECTS, TOXICITY, SUBLETHAL EFFECTS, UPTAKE, RELEASE,
0217 MARINE ORGANISMS, HYDROCARBONS , UPTAKE, METABOLISM, RELEASE, SUBLETHAL EFFECTS, *BIOCHEMICAL CHANGES,
0218 MARINE ORGANISMS, CONTAMINANTS, BIOLOGICAL EFFECTS, PETROLEUM PRODUCTS, *PHYSIOLOGICAL RESPONSE,
0236 MARINE ORGANISMS, HYDROCARBONS , BIOLOGICAL EFFECTS,
0240 MARINE ORGANISMS, INTERTIDAL ZONE, HABITAT, ECOSYSTEMS, BIOLOGICAL EFFECTS, ARCTIC, SUBARCTIC REGIONS,
0243 MARINE ORGANISMS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING, OIL SPILLS, *DRILLING MUD COMPONENTS,
0244 MARINE ORGANISMS, BIOLOGICAL EFFECTS,DRILLING , OFFSHORE PRODUCTION, PLATFORMS, SEDIMENTS, SANTA BARBARA CHANNEL,
0255 MARINE ORGANISMS, DRILLING , TOXICITY, *SHRIMP, *DRILLING FLUID ADDITIVES,
0261 MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BALLAST , ALASKA, WASTEWATERS, PIPELINES, OIL SPILLS, *PORT VALDEZ,
0263 MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, CHROMATOGRAPHY, SOURCES, OFFSHORE PRODUCTION,
0268 MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, OFFSHORE DRILLING, PLATFORMS, *DRILLING DISCHARGES,
0273 MARINE ORGANISMS, ICE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, OFFSHORE DEVELOPMENT, PLANTS, OCS,
0274 MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OFFSHORE DRILLING,
0288 MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, OXIDATION, TOXICITY, *PHOTOOXIDATION ,
0295 MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, DISTRIBUTION, SEAWATER, SEDIMENTS,
0164 MARSHES, FUEL OIL, CRUSTACEANS, BIOLOGICAL EFFECTS, MORTALITY, REPRODUCTION, MASSACHUSETTS,
0172 MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, *SPECIES REDUCTION,
0173 MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, SAMPLING, *SPECIES REDUCTION,
0184 MARSHES, FUEL OIL, OIL SPILLS, RESTORATION, SEDIMENTS, MASSACHUSETTS, *MARSH GRASS,
0207 MARSHES, FUEL OIL, FISH, CONTAMINATION, CHRONIC EFFECTS, TOXICITY, *BIOCHEMICAL CHANGES,
0026 MASSACHUSETTS, HYDROCARBONS , CHROMATOGRAPHY, CHEMICAL ANALYSIS, SAMPLING, SEDIMENTS, *BUZZARDS BAY,
0067 MASSACHUSETTS, GEORGES BANK, CONTINGENCY PLANNING, SPILL CLEANUP, MODELS, OFFSHORE DEVELOPMENT,
0164 MASSACHUSETTS, MARSHES, FUEL OIL, CRUSTACEANS, BIOLOGICAL EFFECTS, MORTALITY, REPRODUCTION,
0184 MASSACHUSETTS, MARSHES, FUEL OIL, OIL SPILLS, RESTORATION, SEDIMENTS, *MARSH GRASS,

0209 MASSACHUSETTS, MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, BENTHOS, OIL SPILLS, MORTALITY,
0285 MASSACHUSETTS, INDUSTRIES, HARBORS, MOVEMENT, SEDIMENTATION, *NEW BEDFORD HARBOR,
0028 MEDITERRANEAN SEA, FATE, BEHAVIOR, SAMPLING, MOVEMENT, SEA SURFACE,
0239 MEDITERRANEAN SEA, ENVIRONMENTAL DETERIORATION, CONTAMINATION,
0307 MEDITERRANEAN SEA, LEGISLATION, INTERNATIONAL AGREEMENTS, POLLUTION CONTROL, *UN CONFERENCE/LAW OF THE SEA,
0308 MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, ECONOMICS, POLLUTION CONTROL, MONITORING, UN, *UNEP,
0122 METABOLISM, WASTEWATER TREATMENT, REFINERIES, TOXICITY, *HOLDING POND,
0169 METABOLISM, MARINE ORGANISMS, HYDROCARBONS , FUEL OIL, CRUSTACEANS, CRUDE OIL, MOLLUSKS,
0208 METABOLISM, HYDROCARBONS , CRUSTACEANS, TOXICITY, *NAPHTHALENE, *LARVAE,
0211 METABOLISM, FISH, TOXICITY, *DEEMULSIFIERS , *CARP ORGANS, *MORPHOLOGICAL CHANGES,
0216 METABOLISM, HYDROCARBONS , DISTRIBUTION, CRUSTACEANS, BENTHOS, *PLESIOPENAEUS EDWARDSIANUS, *N-PARAFFINS,
0217 METABOLISM, MARINE ORGANISMS, HYDROCARBONS , UPTAKE, RELEASE, SUBLETHAL EFFECTS, *BIOCHEMICAL CHANGES,
0002 METULA SPILL, INTERTIDAL ZONE, ESTUARIES, CHRONIC EFFECTS, CHILE, BEACHES,
0301 METULA SPILL, MAGELLAN/STRAIT OF, HYDROCARBONS , FATE, CRUDE OIL, BIODEGRADATION,
0015 MEXICO/GULF OF, HYDROCARBONS , MONITORING, OCEANS, OFFSHORE PRODUCTION,
0045 MEXICO/GULF OF, HYDROCARBONS , SOURCE IDENTIFICATION, PRODUCTION , MISSISSIPPI RIVER,
0161 MEXICO/GULF OF, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, OFFSHORE EXPLORATION, OIL DISCHARGES, SAFETY, STATISTICS,
0249 MEXICO/GULF OF, FISHERIES, FEA, ENVIRONMENTAL EFFECTS, STORAGE, OFFSHORE DEVELOPMENT, *SHRIMP, *SALT DOMES,
0270 MEXICO/GULF OF, ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, OIL INDUSTRY,
0081 MICROORGANISMS, DECOMPOSITION, CRUDE OIL, CONTAMINATION, RESTORATION, SOIL, *NIGERIA,
0177 MICROORGANISMS, FISH, BIOLOGICAL EFFECTS,
0199 MICROORGANISMS, HYDROCARBONS , UPTAKE, *ADHESION,
0200 MICROORGANISMS, HYDROCARBONS , UPTAKE, *GROWTH KINETICS,
R016 MICROORGANISMS, CRUDE OIL, BIODEGRADATION, SAMPLING, PUGET SOUND,
R002 MICROORGANISMS, CONTAMINANTS, SAMPLING, WASTEWATERS, *PRESERVATION,
0045 MISSISSIPPI RIVER, MEXICO/GULF OF, HYDROCARBONS , SOURCE IDENTIFICATION, PRODUCTION ,
0065 MODELS, EQUIPMENT, SPILL CONTAINMENT, *STREAMING-FIBER SYSTEM,
0067 MODELS, MASSACHUSETTS, GEORGES BANK, CONTINGENCY PLANNING, SPILL CLEANUP, OFFSHORE DEVELOPMENT,
0147 MODELS, LEGISLATION, ENVIRONMENTAL PROTECTION, RECYCLING, WASTE OIL,
0223 MODELS, ICE, BLOWOUTS, BEHAVIOR, *ICE SHEET DEFLECTION, *SUBMERGED GAS SOURCE,
0282 MODELS, CONTAMINANTS, SPREADING, OCEANS,
0283 MODELS, OIL SPILLS, MOVEMENT, *WIND DRIFT , *GRAVITY CURRENT,
0286 MODELS, EVAPORATION, OIL SPILLS, WEATHERING,
0290 MODELS, FATE, EKOFISK BLOWOUT, COST ANALYSIS, OIL SPILLS, NORTH SEA, *SLIKTRAK PROGRAM,
0291 MODELS, STATISTICAL ANALYSIS, OFFSHORE DEVELOPMENT, OIL SPILLS, OCS, *SPILL TRAJECTORY,
0298 MODELS, BEHAVIOR, OIL SLICKS,
R005 MODELS, ENVIRONMENTAL EFFECTS, CONTINGENCY PLANNING, RESOURCE MANAGEMENT,
R018 MODELS, FUEL OIL, FATE, ECOSYSTEMS, BIOLOGICAL EFFECTS, BENTHOS, PLANKTON ,
R019 MODELS, CONTINGENCY PLANNING, POLLUTION PREVENTION, PUGET SOUND,
R015 MODELS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES, OIL TRANSPORT, REFINERIES, MOVEMENT, PUGET SOUND,
0166 MOLLUSKS, CRUSTACEANS, CHRONIC EFFECTS, CHEMICAL EFFECTS, BEHAVIOR, OIL SPILLS,
0169 MOLLUSKS, METABOLISM, MARINE ORGANISMS, HYDROCARBONS , FUEL OIL, CRUSTACEANS, CRUDE OIL,
0176 MOLLUSKS, PETROLEUM PRODUCTS, AROMATIC HYDROCARBONS, TOXICITY, *BARNACLES,
0181 MOLLUSKS, HYDROCARBONS , TOXICITY, SEDIMENTS, *CARBON FLUX, *MYA ARENARIA,
0196 MOLLUSKS, HYDROCARBONS , TOXICITY, RESPIRATION, *MYTILUS EDULIS,
0214 MOLLUSKS, CHRONIC EFFECTS, CALIFORNIA/SOUTHERN, NATURAL SEEPAGE, REPRODUCTION, *SIZE,
0221 MOLLUSKS, FISH, CARCINOGENS, BLACK SEA, UPTAKE, PAH,
R001 MOLLUSKS, CHEMICAL ANALYSIS, BASELINE STUDIES, SAMPLING, SEDIMENTS, PUGET SOUND,
0001 MONITORING, LAW ENFORCEMENT, GOVERNMENT AGENCIES, DETECTION, ARGO MERCHANT SPILL, SAMPLING,
0012 MONITORING, LAKES , DETECTION, COASTS, REMOTE SENSING, BAYS, RIVERS, USCG, *CONTINUOUS WAVE LASER,
0013 MONITORING, EQUIPMENT, DETECTION, PETROLEUM PRODUCTS, OIL SPILLS, *OIL SENSOR,
0014 MONITORING, EQUIPMENT, DRIFT, OIL SLICKS, MOVEMENT, *BUOY,
0015 MONITORING, MEXICO/GULF OF, HYDROCARBONS , OCEANS, OFFSHORE PRODUCTION,
0016 MONITORING, DESIGN-ENGINEERING, CHEMICAL ANALYSIS, SAMPLING, PATENT, *REMOTE OPERATION,
0017 MONITORING, HYDROCARBONS , CHEMICAL ANALYSIS, *BOOK REVIEW,
0018 MONITORING, EQUIPMENT, DETECTION, DESIGN-ENGINEERING, OIL SPILLS, PATENT, *ALARM DEVICE,
0019 MONITORING, LEGISLATION, ANALYTICAL TECHNIQUES, OIL DISCHARGES, WASTEWATERS, SAMPLING, UK,
0020 MONITORING, EQUIPMENT, DETECTION, RECLAMATION, SAMPLING,
0021 MONITORING, DETECTION, OIL SLICKS, SURVEILLANCE, *OIL-ON-WATER,
0022 MONITORING, ENVIRONMENTAL EFFECTS, CONTAMINANTS, REMOTE SENSING, OIL SPILLS,

0104 MONITORING, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, RESIDUAL OILS, RECYCLING, PATENT, *INFRARED ANALYZER,
0138 MONITORING, ENVIRONMENTAL EFFECTS, DISPOSAL , DESIGN-ENGINEERING, OIL-WATER SEPARATION, REFINERIES, OFFSHORE PRODUCTION, WASTEWATER TREATMENT,
0153 MONITORING, FATE, BIOLOGICAL EFFECTS, BEHAVIOR, POLLUTION CONTROL, SPILL CLEANUP, NOAA, *RESEARCH PROGRAMS,
0253 MONITORING, ENVIRONMENTAL EFFECTS, BLM, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, OCS, NOAA,
0293 MONITORING, DRIFT, DESIGN-ENGINEERING, OIL SLICKS, *TRACKING BUOY,
0308 MONITORING, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, ECONOMICS, POLLUTION CONTROL, UN, *UNEP,
R017 MONITORING, DRIFT, OIL SLICKS, PUGET SOUND, *AERIAL DROGUE STUDY, *PREDICTION,
0164 MORTALITY, MASSACHUSETTS, MARSHES, FUEL OIL, CRUSTACEANS, BIOLOGICAL EFFECTS, REPRODUCTION,
0165 MORTALITY, ENGLAND, BIRDS, OIL SPILLS, SOURCE IDENTIFICATION, NORTH SEA,
0167 MORTALITY, HYDROCARBONS , FUEL OIL, FISH, CRUDE OIL, SUBLETHAL EFFECTS, WSF, *HATCHING SUCCESS,
0168 MORTALITY, CRUSTACEANS, CONTAMINATION, PETROLEUM PRODUCTS, SUBLETHAL EFFECTS, *HOMARUS AMERICANUS,
0174 MORTALITY, CONTAMINATION, BIRDS, UK, *SEABIRDS ,
0186 MORTALITY, CHRONIC EFFECTS, BIRDS, ACUTE EFFECTS, OIL SPILLS, *DUCKS,
0194 MORTALITY, FISH, ARGO MERCHANT SPILL, *NANTUCKET SHOALS, *COD, *POLLOCK, *FISH EGGS,
0209 MORTALITY, MASSACHUSETTS, MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, BENTHOS, OIL SPILLS,
0246 MORTALITY, FISH, DRILLING , ARCTIC, TOXICITY, *SALMO GAIRDNERI, *DRILLING MUDS,
0014 MOVEMENT, MONITORING, EQUIPMENT, DRIFT, OIL SLICKS, *BUOY,
0028 MOVEMENT, MEDITERRANEAN SEA, FATE, BEHAVIOR, SAMPLING, SEA SURFACE,
0283 MOVEMENT, MODELS, OIL SPILLS, *WIND DRIFT , *GRAVITY CURRENT,
0285 MOVEMENT, MASSACHUSETTS, INDUSTRIES, HARBORS, SEDIMENTATION, *NEW BEDFORD HARBOR,
0294 MOVEMENT, SEA SURFACE, OIL SLICKS, OCS, OIL TRANSPORT, OIL DISCHARGES, NEW YORK,
0299 MOVEMENT, ICE, FATE, OFFSHORE DEVELOPMENT, *OIL-IN-ICE ,
R015 MOVEMENT, MODELS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES, OIL TRANSPORT, REFINERIES, PUGET SOUND,
0023 NATURAL SEEPAGE, CALIFORNIA, REMOTE SENSING, USCG, *RADAR SYSTEMS,
0214 NATURAL SEEPAGE, MOLLUSKS, CHRONIC EFFECTS, CALIFORNIA/SOUTHERN, REPRODUCTION, *SIZE,
0294 NEW YORK, MOVEMENT, SEA SURFACE, OIL SLICKS, OCS, OIL TRANSPORT, OIL DISCHARGES,
0153 NOAA, MONITORING, FATE, BIOLOGICAL EFFECTS, BEHAVIOR, POLLUTION CONTROL, SPILL CLEANUP, *RESEARCH PROGRAMS,
0163 NOAA, FISH, CONTAMINATION, CHRONIC EFFECTS, BLOWOUTS, OIL SPILLS, PETROLEUM PRODUCTS,
0253 NOAA, MONITORING, ENVIRONMENTAL EFFECTS, BLM, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT, OCS,
0006 NORTH SEA, BIRDS, OIL SPILLS, STATISTICS, UK,
0051 NORTH SEA, CONTAMINATION, SOURCE IDENTIFICATION, TANKERS, PLATFORMS, OIL TERMINAL, OFFSHORE PRODUCTION, OIL DISCHARGES,
0101 NORTH SEA, EQUIPMENT, BALLAST , OIL TERMINAL, WASTEWATER TREATMENT,
0119 NORTH SEA, ENVIRONMENTAL PROTECTION, OCS, OIL DISCHARGES, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, REGULATIONS,
0135 NORTH SEA, ENVIRONMENTAL EFFECTS, CRUDE OIL, OIL-WATER SEPARATION, OIL DISCHARGES, WASTEWATER TREATMENT, UK,
0150 NORTH SEA, EQUIPMENT, EKOFISK BLOWOUT, DESIGN-ENGINEERING, CONTINGENCY PLANNING, SPILL CLEANUP, NORWAY,
0165 NORTH SEA, MORTALITY, ENGLAND, BIRDS, OIL SPILLS, SOURCE IDENTIFICATION,
0189 NORTH SEA, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OFFSHORE DEVELOPMENT, OIL DISCHARGES, PLANTS, PLANKTON ,
0254 NORTH SEA, ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, POLLUTION CONTROL, NORWAY,
0290 NORTH SEA, MODELS, FATE, EKOFISK BLOWOUT, COST ANALYSIS, OIL SPILLS, *SLIKTRAK PROGRAM,
0150 NORWAY, NORTH SEA, EQUIPMENT, EKOFISK BLOWOUT, DESIGN-ENGINEERING, CONTINGENCY PLANNING, SPILL CLEANUP,
0254 NORWAY, NORTH SEA, ENVIRONMENTAL EFFECTS, OFFSHORE DEVELOPMENT, POLLUTION CONTROL,
0015 OCEANS, MONITORING, MEXICO/GULF OF, HYDROCARBONS , OFFSHORE PRODUCTION,
0282 OCEANS, MODELS, CONTAMINANTS, SPREADING,
0284 OCEANS, DRIFT, OIL SLICKS, POLLUTION CONTROL, *DRIFT VELOCITY, *WIND, *WAVES,
0296 OCEANS, HYDROCARBONS , FATE, WEATHERING, *POLLUTANT TRANSFER,
0119 OCS, NORTH SEA, ENVIRONMENTAL PROTECTION, OIL DISCHARGES, WASTEWATER TREATMENT, OFFSHORE PRODUCTION, REGULATIONS,
0253 OCS, NOAA, MONITORING, ENVIRONMENTAL EFFECTS, BLM, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT,
0265 OCS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BASELINE STUDIES, ALASKA, OFFSHORE DEVELOPMENT,
0271 OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DEVELOPMENT, OIL SPILLS, *RISK ANALYSIS,
0272 OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OFFSHORE DEVELOPMENT, OIL SPILLS, *RISK ANALYSIS,
0273 OCS, MARINE ORGANISMS, ICE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, OFFSHORE DEVELOPMENT, PLANTS,

0291 OCS, MODELS, STATISTICAL ANALYSIS, OFFSHORE DEVELOPMENT, OIL SPILLS, *SPILL TRAJECTORY,
0294 OCS, NEW YORK, MOVEMENT, SEA SURFACE, OIL SLICKS, OIL TRANSPORT, OIL DISCHARGES,
0067 OFFSHORE DEVELOPMENT, MODELS, MASSACHUSETTS, GEORGES BANK, CONTINGENCY PLANNING, SPILL CLEANUP,
0189 OFFSHORE DEVELOPMENT, NORTH SEA, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL DISCHARGES, PLANTS, PLANKTON ,
0249 OFFSHORE DEVELOPMENT, MEXICO/GULF OF, FISHERIES, FEA, ENVIRONMENTAL EFFECTS, STORAGE, *SHRIMP, *SALT DOMES,
0250 OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, OIL-GAS LEASING, REGULATIONS, US GOVERNMENT, STATE GOVERNMENTS,
0252 OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ECONOMICS, ONSHORE IMPACTS, REGULATIONS, OIL-GAS LEASING,
0253 OFFSHORE DEVELOPMENT, OCS, NOAA, MONITORING, ENVIRONMENTAL EFFECTS, BLM, BASELINE STUDIES, ALASKA,
0254 OFFSHORE DEVELOPMENT, NORWAY, NORTH SEA, ENVIRONMENTAL EFFECTS, POLLUTION CONTROL,
0258 OFFSHORE DEVELOPMENT, GEORGES BANK, FISHERIES, ECONOMIC EFFECTS, OFFSHORE EXPLORATION, OIL INDUSTRY,
0260 OFFSHORE DEVELOPMENT, ONSHORE IMPACTS, US, SCOTLAND, *PLANNING,
0262 OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ARCTIC,
0265 OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BASELINE STUDIES, ALASKA,
0266 OFFSHORE DEVELOPMENT, ENVIRONMENTAL DETERIORATION, CONSERVATION, ALASKA, OIL INDUSTRY, PIPELINES,
0269 OFFSHORE DEVELOPMENT, LOUISIANA, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, PORTS, ONSHORE IMPACTS, *SUPERPORT,
0270 OFFSHORE DEVELOPMENT, MEXICO/GULF OF, ENVIRONMENTAL EFFECTS, OIL INDUSTRY,
0271 OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OIL SPILLS, *RISK ANALYSIS,
0272 OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, OIL SPILLS, *RISK ANALYSIS,
0273 OFFSHORE DEVELOPMENT, OCS, MARINE ORGANISMS, ICE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS, PLANTS,
0291 OFFSHORE DEVELOPMENT, OCS, MODELS, STATISTICAL ANALYSIS, OIL SPILLS, *SPILL TRAJECTORY,
0299 OFFSHORE DEVELOPMENT, MOVEMENT, ICE, FATE, *OIL-IN-ICE ,
0305 OFFSHORE DEVELOPMENT, PORTS, REGULATIONS, USCG, *DEEPWATER PORT ACT,
0113 OFFSHORE DRILLING, DISPOSAL , WASTEWATERS, POLLUTION PREVENTION, *OILY DRILL CUTTINGS,
0243 OFFSHORE DRILLING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS, *DRILLING MUD COMPONENTS,
0268 OFFSHORE DRILLING, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, PLATFORMS, *DRILLING DISCHARGES,
0274 OFFSHORE DRILLING, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS,
0161 OFFSHORE EXPLORATION, MEXICO/GULF OF, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, OIL DISCHARGES, SAFETY, STATISTICS,
0242 OFFSHORE EXPLORATION, MARINE MAMMALS, BIRDS, BIOLOGICAL EFFECTS, BEAUFORT SEA, ARCTIC,
0258 OFFSHORE EXPLORATION, OFFSHORE DEVELOPMENT, GEORGES BANK, FISHERIES, ECONOMIC EFFECTS, OIL INDUSTRY,
0264 OFFSHORE EXPLORATION, ICE, ENVIRONMENTAL EFFECTS, CANADA, BEAUFORT SEA, BASELINE STUDIES,
0267 OFFSHORE EXPLORATION, LEGISLATION, ENVIRONMENTAL EFFECTS, OFFSHORE PRODUCTION, OIL SPILLS, ONSHORE IMPACTS,
0015 OFFSHORE PRODUCTION, OCEANS, MONITORING, MEXICO/GULF OF, HYDROCARBONS ,
0051 OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION, SOURCE IDENTIFICATION, TANKERS, PLATFORMS, OIL TERMINAL, OIL DISCHARGES,
0119 OFFSHORE PRODUCTION, OCS, NORTH SEA, ENVIRONMENTAL PROTECTION, OIL DISCHARGES, WASTEWATER TREATMENT, REGULATIONS,
0138 OFFSHORE PRODUCTION, MONITORING, ENVIRONMENTAL EFFECTS, DISPOSAL , DESIGN-ENGINEERING, OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT,
0244 OFFSHORE PRODUCTION, MARINE ORGANISMS, BIOLOGICAL EFFECTS,DRILLING , PLATFORMS, SEDIMENTS, SANTA BARBARA CHANNEL,
0263 OFFSHORE PRODUCTION, MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, CHROMATOGRAPHY, SOURCES,
0267 OFFSHORE PRODUCTION, OFFSHORE EXPLORATION, LEGISLATION, ENVIRONMENTAL EFFECTS, OIL SPILLS, ONSHORE IMPACTS,
0019 OIL DISCHARGES, MONITORING, LEGISLATION, ANALYTICAL TECHNIQUES, WASTEWATERS, SAMPLING, UK,
0051 OIL DISCHARGES, OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION, SOURCE IDENTIFICATION, TANKERS, PLATFORMS, OIL TERMINAL,
0119 OIL DISCHARGES, OFFSHORE PRODUCTION, OCS, NORTH SEA, ENVIRONMENTAL PROTECTION, WASTEWATER TREATMENT, REGULATIONS,
0135 OIL DISCHARGES, NORTH SEA, ENVIRONMENTAL EFFECTS, CRUDE OIL, OIL-WATER SEPARATION, WASTEWATER TREATMENT, UK,
0154 OIL DISCHARGES, MARINE ORGANISMS, GUIDELINES, BIOLOGICAL EFFECTS, BALLAST , POLLUTION CONTROL, OIL TERMINAL, REGULATIONS,
0161 OIL DISCHARGES, OFFSHORE EXPLORATION, MEXICO/GULF OF, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, SAFETY, STATISTICS,

0189 OIL DISCHARGES, OFFSHORE DEVELOPMENT, NORTH SEA, MARINE ORGANISMS, BIOLOGICAL EFFECTS, PLANTS, PLANKTON ,
0232 OIL DISCHARGES, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BEHAVIOR, PETROLEUM PRODUCTS, *REVIEW,
0294 OIL DISCHARGES, OCS, NEW YORK, MOVEMENT, SEA SURFACE, OIL SLICKS, OIL TRANSPORT,
0304 OIL DISCHARGES, REGULATIONS, SPILL CLEANUP, POLLUTION CONTROL, USCG,
0123 OIL FIELDS, DRILLING , WASTE OIL DISPOSAL, REGULATIONS, STATE GOVERNMENTS, TEXAS,
0250 OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, REGULATIONS, US GOVERNMENT, STATE GOVERNMENTS,
0252 OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ECONOMICS, ONSHORE IMPACTS, REGULATIONS,
0008 OIL INDUSTRY, EKOFISK BLOWOUT, ARGO MERCHANT SPILL, SANTA BARBARA CHANNEL, TORREY CANYON, TANKERS, POLLUTION PREVENTION,
0041 OIL INDUSTRY, CHROMATOGRAPHY, CHEMICAL ANALYSIS, PETROCHEMICALS,
0121 OIL INDUSTRY, GUIDELINES, DRILLING , DISPOSAL , TOXICITY, WASTEWATERS, *DRILLING FLUIDS,
0158 OIL INDUSTRY, EPA, ENVIRONMENTAL MANAGEMENT, ECONOMICS, API,
0159 OIL INDUSTRY, POLLUTION CONTROL, SURVEILLANCE, *SURVEY,
0246 OIL INDUSTRY, ECONOMICS, COST ANALYSIS, API, REFINERIES, POLLUTION CONTROL, *ENVIRONMENTAL EXPENDITURES,
0258 OIL INDUSTRY, OFFSHORE EXPLORATION, OFFSHORE DEVELOPMENT, GEORGES BANK, FISHERIES, ECONOMIC EFFECTS,
0266 OIL INDUSTRY, OFFSHORE DEVELOPMENT, ENVIRONMENTAL DETERIORATION, CONSERVATION, ALASKA, PIPELINES,
0270 OIL INDUSTRY, OFFSHORE DEVELOPMENT, MEXICO/GULF OF, ENVIRONMENTAL EFFECTS,
0303 OIL INDUSTRY, LEGISLATION, CALIFORNIA, US, *COASTAL ZONE MANAGEMENT,
R020 OIL INDUSTRY, BIBLIOGRAPHIES, RESOURCE MANAGEMENT, POLLUTION CONTROL, PUGET SOUND,
R003 OIL INDUSTRY, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEAWATER, SEDIMENT, *TRANSPORT, OIL TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
0275 OIL SHALE, BIODEGRADATION, BACTERIA, ALGAE, TAR, PLANKTON ,
0009 OIL SLICKS, CANADA, SOURCE IDENTIFICATION,
0014 OIL SLICKS, MOVEMENT, MONITORING, EQUIPMENT, DRIFT, *BUOY,
0021 OIL SLICKS, MONITORING, DETECTION, SURVEILLANCE, *OIL-ON-WATER,
0024 OIL SLICKS, REMOTE SENSING, SEAWATER, *LIDAR ENERGETICS,
0077 OIL SLICKS, DISPERSANTS, SPILL CLEANUP, PATENT, *RESIN,
0222 OIL SLICKS, SEA SURFACE, *RADIOLOCATION SIGNALS,
0284 OIL SLICKS, OCEANS, DRIFT, POLLUTION CONTROL, *DRIFT VELOCITY, *WIND, *WAVES,
0289 OIL SLICKS, EKOFISK BLOWOUT, DRIFT, CRUDE OIL,
0293 OIL SLICKS, MONITORING, DRIFT, DESIGN-ENGINEERING, *TRACKING BUOY,
0294 OIL SLICKS, OIL DISCHARGES, OCS, NEW YORK, MOVEMENT, SEA SURFACE, OIL TRANSPORT,
0298 OIL SLICKS, MODELS, BEHAVIOR,
R017 OIL SLICKS, MONITORING, DRIFT, PUGET SOUND, *AERIAL DROGUE STUDY, *PREDICTION,
0003 OIL SPILLS, MARINE ORGANISMS, FISHERIES, EKOFISK BLOWOUT, CHRONIC EFFECTS,
0004 OIL SPILLS, ARGO MERCHANT SPILL, STATISTICS, TANKERS,
0005 OIL SPILLS, ICE, *HUDSON RIVER,
0006 OIL SPILLS, NORTH SEA, BIRDS, STATISTICS, UK,
0007 OIL SPILLS, INFORMATION SYSTEMS, SOURCES, *SPILL DIRECTORY,
0011 OIL SPILLS, STATISTICAL ANALYSIS, TANKERS, US, *BARGES,
0013 OIL SPILLS, MONITORING, EQUIPMENT, DETECTION, PETROLEUM PRODUCTS, *OIL SENSOR,
0018 OIL SPILLS, MONITORING, EQUIPMENT, DETECTION, DESIGN-ENGINEERING, PATENT, *ALARM DEVICE,
0022 OIL SPILLS, MONITORING, ENVIRONMENTAL EFFECTS, CONTAMINANTS, REMOTE SENSING,
0025 OIL SPILLS, EPA, REMOTE SENSING, SPILL CLEANUP, *REMOTE SENSING SYSTEMS,
0076 OIL SPILLS, LEGISLATION, BOOMS, SPILL CLEANUP, SKIMMERS, POLLUTION PREVENTION,
0087 OIL SPILLS, LEAKAGE, TANKERS, STATISTICS, OIL TRANSPORT, US,
0132 OIL SPILLS, HYDROCARBONS , GRAVITY SEPARATION, EQUIPMENT, OIL-WATER SEPARATION,
0162 OIL SPILLS, BIRDS, BIOLOGICAL EFFECTS, POLLUTION CONTROL,
0163 OIL SPILLS, NOAA, FISH, CONTAMINATION, CHRONIC EFFECTS, BLOWOUTS, PETROLEUM PRODUCTS,
0165 OIL SPILLS, NORTH SEA, MORTALITY, ENGLAND, BIRDS, SOURCE IDENTIFICATION,
0166 OIL SPILLS, MOLLUSKS, CRUSTACEANS, CHRONIC EFFECTS, CHEMICAL EFFECTS, BEHAVIOR,
0172 OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, PLANTS, SAMPLING, *SPECIES REDUCTION,
0173 OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, PLANTS, SAMPLING, *SPECIES REDUCTION,
0184 OIL SPILLS, MASSACHUSETTS, MARSHES, FUEL OIL, RESTORATION, SEDIMENTS, *MARSH GRASS,
0186 OIL SPILLS, MORTALITY, CHRONIC EFFECTS, BIRDS, ACUTE EFFECTS, *DUCKS,
0209 OIL SPILLS, MORTALITY, MASSACHUSETTS, MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, BENTHOS,
0228 OIL SPILLS, LIABILITY, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CHESAPEAKE BAY, BIRDS, BEACHES,
0230 OIL SPILLS, FATE, CRUDE OIL, BIOLOGICAL EFFECTS, SOURCES, PETROLEUM PRODUCTS, SLUDGE ,
0233 OIL SPILLS, SPILL CLEANUP, SPILL DISPOSAL,
0235 OIL SPILLS, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, SPILL CLEANUP, SURFACTANTS,
0237 OIL SPILLS, BIODEGRADATION, TOXICITY, SPILL CLEANUP, *INDUSTRIAL POLLUTANTS,
0241 OIL SPILLS, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CANADA, RESIDUAL OILS, *ALEXANDRIA BAY SPILL,

0243 OIL SPILLS, OFFSHORE DRILLING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, *DRILLING MUD COMPONENTS,
0256 OIL SPILLS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, SUBARCTIC REGIONS,
0261 OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BALLAST , ALASKA, WASTEWATERS, PIPELINES, *PORT VALDEZ,
0267 OIL SPILLS, OFFSHORE PRODUCTION, OFFSHORE EXPLORATION, LEGISLATION, ENVIRONMENTAL EFFECTS, ONSHORE IMPACTS,
0271 OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, *RISK ANALYSIS,
0272 OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, ATLANTIC COAST, *RISK ANALYSIS,
0277 OIL SPILLS, DISPOSAL , BIODEGRADATION, SOIL, SLUDGE , *AERATION, *NUTRIENT ADDITION,
0283 OIL SPILLS, MOVEMENT, MODELS, *WIND DRIFT , *GRAVITY CURRENT,
0286 OIL SPILLS, MODELS, EVAPORATION, WEATHERING,
0290 OIL SPILLS, NORTH SEA, MODELS, FATE, EKOFISK BLOWOUT, COST ANALYSIS, *SLIKTRAK PROGRAM,
0291 OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, MODELS, STATISTICAL ANALYSIS, *SPILL TRAJECTORY,
0306 OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, COMPENSATION, SPILL CLEANUP, *OIL SPILL FUND,
R012 OIL SPILLS, HABITAT, DISTRIBUTION, BIRDS, PUGET SOUND,
0115 OIL TANKS, CRUDE OIL, RESIDUAL OILS, WASTE OIL DISPOSAL, TANKERS, POLLUTION PREVENTION,
0116 OIL TANKS, CRUDE OIL, SLUDGE , PATENT, *SLUDGE REMOVAL,
0051 OIL TERMINAL, OIL DISCHARGES, OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION, SOURCE IDENTIFICATION, TANKERS, PLATFORMS,
0101 OIL TERMINAL, NORTH SEA, EQUIPMENT, BALLAST , WASTEWATER TREATMENT,
0154 OIL TERMINAL, OIL DISCHARGES, MARINE ORGANISMS, GUIDELINES, BIOLOGICAL EFFECTS, BALLAST , POLLUTION CONTROL, REGULATIONS,
0083 OIL TRANSFER, LEAKAGE, SPILL CONTAINMENT, POLLUTION PREVENTION, PORTS, *CONTAINMENT RING,
0084 OIL TRANSFER, BALLAST , *COMPUTER SIMULATION SYSTEM, TANKERS, POLLUTION PREVENTION,
0085 OIL TRANSPORT, ENVIRONMENTAL EFFECTS, CRUDE OIL, ALASKA, PIPELINES, TANKERS, WATER QUALITY, US, *WEST COAST,
0086 OIL TRANSPORT, ENVIRONMENTAL EFFECTS, EIS, CRUDE OIL, ALASKA, US,
0087 OIL TRANSPORT, OIL SPILLS, LEAKAGE, TANKERS, STATISTICS, US,
0294 OIL TRANSPORT, OIL SLICKS, OIL DISCHARGES, OCS, NEW YORK, MOVEMENT, SEA SURFACE,
R003 OIL TRANSPORT, OIL INDUSTRY, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEAWATER, SEDIMENT, *TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
R015 OIL TRANSPORT, MOVEMENT, MODELS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES, REFINERIES, PUGET SOUND,
0070 OIL-WATER SEPARATION, INDUSTRIES, EQUIPMENT, SPILL CLEANUP, POLLUTION PREVENTION,
0091 OIL-WATER SEPARATION, EQUIPMENT, COALESCENCE, BILGES, POLLUTION CONTROL, PATENT,
0094 OIL-WATER SEPARATION, GRAVITY SEPARATION, PRODUCTION , REFINERIES, *OIL INTERCEPTORS,
0099 OIL-WATER SEPARATION, INDUSTRIES, WASTEWATER TREATMENT, WASTE OIL TREATMENT, *TREATMENT PROCESSES,
0105 OIL-WATER SEPARATION, FILTRATION , EQUIPMENT, BILGES, PATENT,
0111 OIL-WATER SEPARATION, FLOCCULATION, EMULSIONS, PATENT,
0112 OIL-WATER SEPARATION, SLUDGE , RECLAMATION, REFINERIES, PATENT,
0129 OIL-WATER SEPARATION, FLOTATION, BALLAST , WASTEWATER TREATMENT, REFINERIES,
0132 OIL-WATER SEPARATION, OIL SPILLS, HYDROCARBONS , GRAVITY SEPARATION, EQUIPMENT,
0133 OIL-WATER SEPARATION, GRAVITY SEPARATION, EQUIPMENT, DESIGN-ENGINEERING, WASTEWATER TREATMENT,
0134 OIL-WATER SEPARATION, FLOTATION, EMULSIONS, SURFACTANTS, SEAWATER,
0135 OIL-WATER SEPARATION, OIL DISCHARGES, NORTH SEA, ENVIRONMENTAL EFFECTS, CRUDE OIL, WASTEWATER TREATMENT, UK,
0136 OIL-WATER SEPARATION, LUBRICATING OIL, HYDROCARBONS , FUELS , EMULSIONS, PETROLEUM PRODUCTS, *AERATION,
0137 OIL-WATER SEPARATION, FILTRATION , WASTEWATER TREATMENT, PATENT,
0138 OIL-WATER SEPARATION, OFFSHORE PRODUCTION, MONITORING, ENVIRONMENTAL EFFECTS, DISPOSAL , DESIGN-ENGINEERING, REFINERIES, WASTEWATER TREATMENT,
0139 OIL-WATER SEPARATION, GRAVITY SEPARATION, FLOTATION, FILTRATION , EQUIPMENT, REFINERIES, WASTEWATER TREATMENT,
0140 OIL-WATER SEPARATION, EMULSIONS, ADSORPTION, PATENT, *SYNTHETIC FIBERS,
0141 OIL-WATER SEPARATION, FLOTATION, EMULSIONS, DISPERSIONS, WASTEWATER TREATMENT, PATENT,
0142 OIL-WATER SEPARATION, EQUIPMENT, PATENT, *ELECTROSTATIC SEPARATION,
0143 OIL-WATER SEPARATION, GRAVITY SEPARATION, SPILL CLEANUP, PATENT,
0144 OIL-WATER SEPARATION, EQUIPMENT, EMULSIONS, PATENT,
0145 OIL-WATER SEPARATION, GRAVITY SEPARATION, EQUIPMENT, DESIGN-ENGINEERING, COALESCENCE, PATENT,
0146 OIL-WATER SEPARATION, COALESCENCE,
0247 OIL WELLS, FISH, ENVIRONMENTAL EFFECTS, DRILLING , TOXICITY, *SALMON, *DRILLING MUDS,
0257 OIL WELLS, GROUNDWATER, DRILLING , CONTAMINATION, *DRILLING FLUIDS, *WELL COMPLETION,
0252 ONSHORE IMPACTS, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ECONOMICS, REGULATIONS,
0260 ONSHORE IMPACTS, OFFSHORE DEVELOPMENT, US, SCOTLAND, *PLANNING,
0267 ONSHORE IMPACTS, OIL SPILLS, OFFSHORE PRODUCTION, OFFSHORE EXPLORATION, LEGISLATION, ENVIRONMENTAL EFFECTS,

0269 ONSHORE IMPACTS, OFFSHORE DEVELOPMENT, LOUISIANA, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, PORTS, *SUPERPORT,
0278 OXIDATION, JAPAN, HYDROCARBONS , COASTS, BIODEGRADATION, BACTERIA, *ENUMERATION METHODS,
0287 OXIDATION, FUEL OIL, BIOLOGICAL EFFECTS, TOXICITY, YEASTS, *PHOTOOXIDATION ,
0288 OXIDATION, MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, TOXICITY, *PHOTOOXIDATION ,
0033 PAH, LAKES , ANALYTICAL TECHNIQUES, SEDIMENTS, RIVERS,
0034 PAH, CHROMATOGRAPHY, BACTERIA, *MICROBIAL TRANSFORMATION,
0215 PAH, LAKES , FUEL OIL, TOXICITY, WASTEWATER TREATMENT, *SALAMANDERS, *DIESEL OIL, *ASPHALT,
0221 PAH, MOLLUSKS, FISH, CARCINOGENS, BLACK SEA, UPTAKE,
0016 PATENT, MONITORING, DESIGN-ENGINEERING, CHEMICAL ANALYSIS, SAMPLING, *REMOTE OPERATION,
0018 PATENT, OIL SPILLS, MONITORING, EQUIPMENT, DETECTION, DESIGN-ENGINEERING, *ALARM DEVICE,
0053 PATENT, SPILL CONTAINMENT, YEASTS, *GELLING AGENT,
0054 PATENT, ADSORPTION, SPILL CONTAINMENT, *COLLECTING AGENT,
0072 PATENT, ADSORPTION, SPILL CLEANUP,
0073 PATENT, ABSORPTION, SPILL CLEANUP, *PLANT FIBER MAT,
0077 PATENT, OIL SLICKS, DISPERSANTS, SPILL CLEANUP, *RESIN,
0078 PATENT, SPILL CLEANUP, *COLLECTING AGENT,
0090 PATENT, ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES,
0091 PATENT, OIL-WATER SEPARATION, EQUIPMENT, COALESCENCE, BILGES, POLLUTION CONTROL,
0092 PATENT, INCINERATION, FUEL OIL, WASTE OIL TREATMENT,
0095 PATENT, INCINERATION, FUEL OIL, EMULSIONS, WASTEWATER TREATMENT,
0104 PATENT, MONITORING, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, RESIDUAL OILS, RECYCLING, *INFRARED ANALYZER,
0105 PATENT, OIL-WATER SEPARATION, FILTRATION , EQUIPMENT, BILGES,
0111 PATENT, OIL-WATER SEPARATION, FLOCCULATION, EMULSIONS,
0112 PATENT, OIL-WATER SEPARATION, SLUDGE , RECLAMATION, REFINERIES,
0116 PATENT, OIL TANKS, CRUDE OIL, SLUDGE , *SLUDGE REMOVAL,
0118 PATENT, ADSORPTION, WASTEWATER TREATMENT,
0120 PATENT, EQUIPMENT, DESIGN-ENGINEERING, ADSORPTION, WASTEWATER TREATMENT,
0125 PATENT, EMULSIONS, WASTEWATER TREATMENT, *SULFURIC ACID PITCH,
0127 PATENT, EMULSIONS, ADSORPTION, WASTEWATER TREATMENT,
0128 PATENT, EMULSIONS, WASTEWATER TREATMENT, SURFACTANTS,
0130 PATENT, LUBRICATING OILS, WASTE OIL TREATMENT,
0137 PATENT, OIL-WATER SEPARATION, FILTRATION , WASTEWATER TREATMENT,
0140 PATENT, OIL-WATER SEPARATION, EMULSIONS, ADSORPTION, *SYNTHETIC FIBERS,
0141 PATENT, OIL-WATER SEPARATION, FLOTATION, EMULSIONS, DISPERSIONS, WASTEWATER TREATMENT,
0142 PATENT, OIL-WATER SEPARATION, EQUIPMENT, *ELECTROSTATIC SEPARATION,
0143 PATENT, OIL-WATER SEPARATION, GRAVITY SEPARATION, SPILL CLEANUP,
0144 PATENT, OIL-WATER SEPARATION, EQUIPMENT, EMULSIONS,
0145 PATENT, OIL-WATER SEPARATION, GRAVITY SEPARATION, EQUIPMENT, DESIGN-ENGINEERING, COALESCENCE,
0149 PERSONNEL TRAINING, BLOWOUT PREVENTION, *EARLY WARNING TECHNIQUES,
0156 PERSONNEL TRAINING, BEHAVIOR, ARGO MERCHANT SPILL, POLLUTION CONTROL, TANKERS, SPILL CLEANUP,
0157 PERSONNEL TRAINING, EQUIPMENT, ARGO MERCHANT SPILL, POLLUTION PREVENTION, TANKERS, SPILL CLEANUP,
0041 PETROCHEMICALS, OIL INDUSTRY, CHROMATOGRAPHY, CHEMICAL ANALYSIS,
0131 PETROCHEMICALS, FLOTATION, FLOCCULATION, ACTIVATED SLUDGE, WASTEWATER TREATMENT, REFINERIES,
0013 PETROLEUM PRODUCTS, OIL SPILLS, MONITORING, EQUIPMENT, DETECTION, *OIL SENSOR,
0027 PETROLEUM PRODUCTS, CHEMICAL ANALYSIS, SAMPLING, SEAWATER, *NAGASAKI BAY,
0030 PETROLEUM PRODUCTS, CHESAPEAKE BAY, BIODEGRADATION, SAMPLING, SEAWATER, SEDIMENTS, *MUTAGENIC SUBSTANCES,
0036 PETROLEUM PRODUCTS, CHROMATOGRAPHY, SOURCE IDENTIFICATION,
0038 PETROLEUM PRODUCTS, FUEL OIL, CRUDE OIL, SOURCE IDENTIFICATION, SPECTROSCOPY,
0039 PETROLEUM PRODUCTS, ENVIRONMENTAL EFFECTS, CONTAMINANTS, ANALYTICAL TECHNIQUES, TOXICITY,
0049 PETROLEUM PRODUCTS, FUEL OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, RESIDUAL OILS,
0050 PETROLEUM PRODUCTS, SOURCE IDENTIFICATION, RESIDUAL OILS, STATISTICAL ANALYSIS, *INFRARED SPECTROPHOTOMETRY,
0106 PETROLEUM PRODUCTS, FLOTATION, WASTEWATER TREATMENT,
0136 PETROLEUM PRODUCTS, OIL-WATER SEPARATION, LUBRICATING OIL, HYDROCARBONS , FUELS , EMULSIONS, *AERATION,
0163 PETROLEUM PRODUCTS, OIL SPILLS, NOAA, FISH, CONTAMINATION, CHRONIC EFFECTS, BLOWOUTS,
0168 PETROLEUM PRODUCTS, MORTALITY, CRUSTACEANS, CONTAMINATION, SUBLETHAL EFFECTS, *HOMARUS AMERICANUS,
0176 PETROLEUM PRODUCTS, MOLLUSKS, AROMATIC HYDROCARBONS, TOXICITY, *BARNACLES,
0193 PETROLEUM PRODUCTS, INTERTIDAL ZONE, CRUSTACEANS, WASTE OIL, TOXICITY, *LABORATORY CULTURES,
0201 PETROLEUM PRODUCTS, HYDROCARBONS , CRUSTACEANS, TOXICITY, *BALANUS,

0218 PETROLEUM PRODUCTS, MARINE ORGANISMS, CONTAMINANTS, BIOLOGICAL EFFECTS, *PHYSIOLOGICAL RESPONSE,
0230 PETROLEUM PRODUCTS, OIL SPILLS, FATE, CRUDE OIL, BIOLOGICAL EFFECTS, SOURCES, SLUDGE ,
0232 PETROLEUM PRODUCTS, OIL DISCHARGES, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, BEHAVIOR, *REVIEW,
0082 PIPELINES, ECONOMICS, ALASKA, *ACCIDENTS,
0085 PIPELINES, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, CRUDE OIL, ALASKA, TANKERS, WATER QUALITY, US, *WEST COAST,
0089 PIPELINES, DISPOSAL , BALLAST , ALASKA COAST, *TREATED EFFLUENT,
0261 PIPELINES, OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BALLAST , ALASKA, WASTEWATERS, *PORT VALDEZ,
0266 PIPELINES, OIL INDUSTRY, OFFSHORE DEVELOPMENT, ENVIRONMENTAL DETERIORATION, CONSERVATION, ALASKA,
0189 PLANKTON , OIL DISCHARGES, OFFSHORE DEVELOPMENT, NORTH SEA, MARINE ORGANISMS, BIOLOGICAL EFFECTS, PLANTS,
0191 PLANKTON , FUEL OIL, BIOLOGICAL EFFECTS, BIODEGRADATION,
0192 PLANKTON , FUEL OIL, BIOLOGICAL EFFECTS,
0275 PLANKTON , OIL SHALE, BIODEGRADATION, BACTERIA, ALGAE, TAR,
R018 PLANKTON , MODELS, FUEL OIL, FATE, ECOSYSTEMS, BIOLOGICAL EFFECTS, BENTHOS,
R011 PLANKTON , INTERTIDAL ZONE, DISTRIBUTION, BASELINE STUDIES, *STRAIT OF JUAN DE FUCA,
0172 PLANTS, OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, SAMPLING, *SPECIES REDUCTION,
0173 PLANTS, OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, SAMPLING, *SPECIES REDUCTION,
0189 PLANTS, PLANKTON , OIL DISCHARGES, OFFSHORE DEVELOPMENT, NORTH SEA, MARINE ORGANISMS, BIOLOGICAL EFFECTS,
0245 PLANTS, DRILLING , TOXICITY, *GROWTH, *DRILLING FLUID COMPONENTS,
0273 PLANTS, OFFSHORE DEVELOPMENT, OCS, MARINE ORGANISMS, ICE, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC, ANIMALS,
0051 PLATFORMS, OIL TERMINAL, OIL DISCHARGES, OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION, SOURCE IDENTIFICATION, TANKERS,
0244 PLATFORMS, OFFSHORE PRODUCTION, MARINE ORGANISMS, BIOLOGICAL EFFECTS,DRILLING , SEDIMENTS, SANTA BARBARA CHANNEL,
0268 PLATFORMS, OFFSHORE DRILLING, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, *DRILLING DISCHARGES,
0037 POLLUTION CONTROL, CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES,
0064 POLLUTION CONTROL, SPILL CLEANUP, *CHEMICAL AGENTS, *HAZARDOUS CHEMICALS,
0069 POLLUTION CONTROL, ENGLAND, SPILL CLEANUP, *SURFACE FILM-FORMING CHEMICALS,
0091 POLLUTION CONTROL, PATENT, OIL-WATER SEPARATION, EQUIPMENT, COALESCENCE, BILGES,
0109 POLLUTION CONTROL, INDUSTRIES, COST ANALYSIS, WASTEWATER TREATMENT, SOLID WASTES,
0153 POLLUTION CONTROL, NOAA, MONITORING, FATE, BIOLOGICAL EFFECTS, BEHAVIOR, SPILL CLEANUP, *RESEARCH PROGRAMS,
0154 POLLUTION CONTROL, OIL TERMINAL, OIL DISCHARGES, MARINE ORGANISMS, GUIDELINES, BIOLOGICAL EFFECTS, BALLAST , REGULATIONS,
0156 POLLUTION CONTROL, PERSONNEL TRAINING, BEHAVIOR, ARGO MERCHANT SPILL, TANKERS, SPILL CLEANUP,
0159 POLLUTION CONTROL, OIL INDUSTRY, SURVEILLANCE, *SURVEY,
0162 POLLUTION CONTROL, OIL SPILLS, BIRDS, BIOLOGICAL EFFECTS,
0248 POLLUTION CONTROL, OIL INDUSTRY, ECONOMICS, COST ANALYSIS, API, REFINERIES, *ENVIRONMENTAL EXPENDITURES,
0254 POLLUTION CONTROL, OFFSHORE DEVELOPMENT, NORWAY, NORTH SEA, ENVIRONMENTAL EFFECTS,
0284 POLLUTION CONTROL, OIL SLICKS, OCEANS, DRIFT, *DRIFT VELOCITY, *WIND, *WAVES,
0304 POLLUTION CONTROL, OIL DISCHARGES, REGULATIONS, SPILL CLEANUP, USCG,
0307 POLLUTION CONTROL, MEDITERRANEAN SEA, LEGISLATION, INTERNATIONAL AGREEMENTS, *UN CONFERENCE/LAW OF THE SEA,
0308 POLLUTION CONTROL, MONITORING, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, ECONOMICS, UN, *UNEP,
0311 POLLUTION CONTROL, INTERNATIONAL CONVENTIONS, CONTINGENCY PLANNING,
R020 POLLUTION CONTROL, OIL INDUSTRY, BIBLIOGRAPHIES, RESOURCE MANAGEMENT, PUGET SOUND,
0008 POLLUTION PREVENTION, OIL INDUSTRY, EKOFISK BLOWOUT, ARGO MERCHANT SPILL, SANTA BARBARA CHANNEL, TORREY CANYON, TANKERS,
0070 POLLUTION PREVENTION, OIL-WATER SEPARATION, INDUSTRIES, EQUIPMENT, SPILL CLEANUP,
0076 POLLUTION PREVENTION, OIL SPILLS, LEGISLATION, BOOMS, SPILL CLEANUP, SKIMMERS,
0079 POLLUTION PREVENTION, DISPERSIONS, BIODEGRADATION, SPILL CLEANUP, SOURCES, STATISTICAL ANALYSIS,
0080 POLLUTION PREVENTION, CONTINGENCY PLANNING, SPILL CLEANUP, US,
0083 POLLUTION PREVENTION, OIL TRANSFER, LEAKAGE, SPILL CONTAINMENT, PORTS, *CONTAINMENT RING,
0084 POLLUTION PREVENTION, OIL TRANSFER, BALLAST , *COMPUTER SIMULATION SYSTEM, TANKERS,
0098 POLLUTION PREVENTION, EQUIPMENT, ENVIRONMENTAL PROTECTION, REFINERIES,
0113 POLLUTION PREVENTION, OFFSHORE DRILLING, DISPOSAL , WASTEWATERS, *OILY DRILL CUTTINGS,
0115 POLLUTION PREVENTION, OIL TANKS, CRUDE OIL, RESIDUAL OILS, WASTE OIL DISPOSAL, TANKERS,
0155 POLLUTION PREVENTION, COASTS, *SYMPOSIUM,
0157 POLLUTION PREVENTION, PERSONNEL TRAINING, EQUIPMENT, ARGO MERCHANT SPILL, TANKERS, SPILL CLEANUP,

0309 POLLUTION PREVENTION, LEGISLATION, FISHERIES, CANADA, *FISHING LIMIT, SURVEILLANCE,
R019 POLLUTION PREVENTION, MODELS, CONTINGENCY PLANNING, PUGET SOUND,
0083 PORTS, POLLUTION PREVENTION, OIL TRANSFER, LEAKAGE, SPILL CONTAINMENT, *CONTAINMENT RING,
0269 PORTS, ONSHORE IMPACTS, OFFSHORE DEVELOPMENT, LOUISIANA, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, *SUPERPORT,
0305 PORTS, OFFSHORE DEVELOPMENT, REGULATIONS, USCG, *DEEPWATER PORT ACT,
0045 PRODUCTION , MISSISSIPPI RIVER, MEXICO/GULF OF, HYDROCARBONS , SOURCE IDENTIFICATION,
0094 PRODUCTION , OIL-WATER SEPARATION, GRAVITY SEPARATION, REFINERIES, *OIL INTERCEPTORS,
0259 PRODUCTION , EXTRACTION, ENVIRONMENTAL EFFECTS, TAR SANDS,
R020 PUGET SOUND, POLLUTION CONTROL, OIL INDUSTRY, BIBLIOGRAPHIES, RESOURCE MANAGEMENT,
R016 PUGET SOUND, MICROORGANISMS, CRUDE OIL, BIODEGRADATION, SAMPLING,
R012 PUGET SOUND, OIL SPILLS, HABITAT, DISTRIBUTION, BIRDS,
R006 PUGET SOUND, FOOD WEB, DISTRIBUTION, CRUDE OIL, BENTHOS, ADSORPTION, *SUSPENDED PARTICLES,
R008 PUGET SOUND, MARINE MAMMALS, DISTRIBUTION, COASTS, *HARBOR SEAL,
R019 PUGET SOUND, POLLUTION PREVENTION, MODELS, CONTINGENCY PLANNING,
R017 PUGET SOUND, OIL SLICKS, MONITORING, DRIFT, *AERIAL DROGUE STUDY, *PREDICTION,
R015 PUGET SOUND, OIL TRANSPORT, MOVEMENT, MODELS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES, REFINERIES,
R001 PUGET SOUND, MOLLUSKS, CHEMICAL ANALYSIS, BASELINE STUDIES, SAMPLING, SEDIMENTS,
R004 PUGET SOUND, CRUDE OIL, BASELINE STUDIES, WASTEWATER TREATMENT, REFINERIES,
0020 RECLAMATION, MONITORING, EQUIPMENT, DETECTION, SAMPLING,
0112 RECLAMATION, PATENT, OIL-WATER SEPARATION, SLUDGE , REFINERIES,
0148 RECLAMATION, LUBRICATING OIL, WASTE OIL,
0104 RECYCLING, PATENT, MONITORING, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, RESIDUAL OILS, *INFRARED ANALYZER,
0147 RECYCLING, MODELS, LEGISLATION, ENVIRONMENTAL PROTECTION, WASTE OIL,
0088 REFINERIES, ECONOMICS, COST ANALYSIS, WASTEWATER TREATMENT, WATER QUALITY,
0090 REFINERIES, PATENT, ACTIVATED SLUDGE, WASTEWATER TREATMENT,
0093 REFINERIES, CONTAMINATION, WASTEWATER TREATMENT, SURFACTANTS, USSR, *DEMULSIFIER,
0094 REFINERIES, PRODUCTION , OIL-WATER SEPARATION, GRAVITY SEPARATION, *OIL INTERCEPTORS,
0096 REFINERIES, INCINERATION, WASTEWATER TREATMENT, SLUDGE , USSR, *WATER PURIFICATION,
0097 REFINERIES, WASTEWATER TREATMENT, *GRANULAR CARBON, *POWDERED CARBON,
0098 REFINERIES, POLLUTION PREVENTION, EQUIPMENT, ENVIRONMENTAL PROTECTION,
0102 REFINERIES, WASTEWATER TREATMENT, ULTRAFILTRATION, *MEMBRANE TECHNIQUES,
0103 REFINERIES, CHEMICAL ANALYSIS, WASTEWATERS, *HEAVY METALS,
0108 REFINERIES, FLOTATION, FLOCCULATION, WASTEWATER TREATMENT, *COAGULATION,
0112 REFINERIES, RECLAMATION, PATENT, OIL-WATER SEPARATION, SLUDGE ,
0122 REFINERIES, METABOLISM, WASTEWATER TREATMENT, TOXICITY, *HOLDING POND,
0126 REFINERIES, DETECTION, ABSORPTION, WASTEWATER TREATMENT, *ACTIVATED CARBON,
0129 REFINERIES, OIL-WATER SEPARATION, FLOTATION, BALLAST , WASTEWATER TREATMENT,
0131 REFINERIES, PETROCHEMICALS, FLOTATION, FLOCCULATION, ACTIVATED SLUDGE, WASTEWATER TREATMENT,
0138 REFINERIES, OIL-WATER SEPARATION, OFFSHORE PRODUCTION, MONITORING, ENVIRONMENTAL EFFECTS, DISPOSAL , DESIGN-ENGINEERING, WASTEWATER TREATMENT,
0139 REFINERIES, OIL-WATER SEPARATION, GRAVITY SEPARATION, FLOTATION, FILTRATION , EQUIPMENT, WASTEWATER TREATMENT,
0248 REFINERIES, POLLUTION CONTROL, OIL INDUSTRY, ECONOMICS, COST ANALYSIS, API, *ENVIRONMENTAL EXPENDITURES,
0251 REFINERIES, ENVIRONMENTAL EFFECTS, EIS, CHESAPEAKE BAY, VIRGINIA, *OYSTER BEDS,
0280 REFINERIES, BIODEGRADATION, WASTE OIL DISPOSAL, SOIL, *SOIL CULTIVATION PROCESS, *LEAD,
R015 REFINERIES, PUGET SOUND, OIL TRANSPORT, MOVEMENT, MODELS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, BASELINE STUDIES,
R004 REFINERIES, PUGET SOUND, CRUDE OIL, BASELINE STUDIES, WASTEWATER TREATMENT,
0119 REGULATIONS, OIL DISCHARGES, OFFSHORE PRODUCTION, OCS, NORTH SEA, ENVIRONMENTAL PROTECTION, WASTEWATER TREATMENT,
0123 REGULATIONS, OIL FIELDS, DRILLING , WASTE OIL DISPOSAL, STATE GOVERNMENTS, TEXAS,
0154 REGULATIONS, POLLUTION CONTROL, OIL TERMINAL, OIL DISCHARGES, MARINE ORGANISMS, GUIDELINES, BIOLOGICAL EFFECTS, BALLAST ,
0250 REGULATIONS, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, US GOVERNMENT, STATE GOVERNMENTS,
0252 REGULATIONS, ONSHORE IMPACTS, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL EFFECTS, ECONOMICS,
0304 REGULATIONS, POLLUTION CONTROL, OIL DISCHARGES, SPILL CLEANUP, USCG,
0305 REGULATIONS, PORTS, OFFSHORE DEVELOPMENT, USCG, *DEEPWATER PORT ACT,
0213 RELEASE, MARINE ORGANISMS, HYDROCARBONS , CHRONIC EFFECTS, TOXICITY, SUBLETHAL EFFECTS, UPTAKE,
0217 RELEASE, METABOLISM, MARINE ORGANISMS, HYDROCARBONS , UPTAKE, SUBLETHAL EFFECTS, *BIOCHEMICAL CHANGES,
0012 REMOTE SENSING, MONITORING, LAKES , DETECTION, COASTS, BAYS, RIVERS, USCG, *CONTINUOUS WAVE LASER,
0022 REMOTE SENSING, OIL SPILLS, MONITORING, ENVIRONMENTAL EFFECTS, CONTAMINANTS,
0023 REMOTE SENSING, NATURAL SEEPAGE, CALIFORNIA, USCG, *RADAR SYSTEMS,
0024 REMOTE SENSING, OIL SLICKS, SEAWATER, *LIDAR ENERGETICS,

0025 REMOTE SENSING, OIL SPILLS, EPA, SPILL CLEANUP, *REMOTE SENSING SYSTEMS,
0164 REPRODUCTION, MORTALITY, MASSACHUSETTS, MARSHES, FUEL OIL, CRUSTACEANS, BIOLOGICAL EFFECTS,
0214 REPRODUCTION, NATURAL SEEPAGE, MOLLUSKS, CHRONIC EFFECTS, CALIFORNIA/SOUTHERN, *SIZE,
0049 RESIDUAL OILS, PETROLEUM PRODUCTS, FUEL OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION,
0050 RESIDUAL OILS, PETROLEUM PRODUCTS, SOURCE IDENTIFICATION, STATISTICAL ANALYSIS, *INFRARED SPECTROPHOTOMETRY,
0104 RESIDUAL OILS, RECYCLING, PATENT, MONITORING, ANALYTICAL TECHNIQUES, WASTEWATER TREATMENT, *INFRARED ANALYZER,
0115 RESIDUAL OILS, POLLUTION PREVENTION, OIL TANKS, CRUDE OIL, WASTE OIL DISPOSAL, TANKERS,
0241 RESIDUAL OILS, OIL SPILLS, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, CANADA, *ALEXANDRIA BAY SPILL,
R020 RESOURCE MANAGEMENT, PUGET SOUND, POLLUTION CONTROL, OIL INDUSTRY, BIBLIOGRAPHIES,
R005 RESOURCE MANAGEMENT, MODELS, ENVIRONMENTAL EFFECTS, CONTINGENCY PLANNING,
0081 RESTORATION, MICROORGANISMS, DECOMPOSITION, CRUDE OIL, CONTAMINATION, SOIL, *NIGERIA,
0184 RESTORATION, OIL SPILLS, MASSACHUSETTS, MARSHES, FUEL OIL, SEDIMENTS, *MARSH GRASS,
0292 RESTORATION, HYDROCARBONS , FATE, ESTUARIES, DELAWARE, SEDIMENTATION, *CORINTHOS OIL SPILL,
0012 RIVERS, REMOTE SENSING, MONITORING, LAKES , DETECTION, COASTS, BAYS, USCG, *CONTINUOUS WAVE LASER,
0033 RIVERS, PAH, LAKES , ANALYTICAL TECHNIQUES, SEDIMENTS,
0161 SAFETY, OIL DISCHARGES, OFFSHORE EXPLORATION, MEXICO/GULF OF, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST, STATISTICS,
0001 SAMPLING, MONITORING, LAW ENFORCEMENT, GOVERNMENT AGENCIES, DETECTION, ARGO MERCHANT SPILL,
0016 SAMPLING, PATENT, MONITORING, DESIGN-ENGINEERING, CHEMICAL ANALYSIS, *REMOTE OPERATION,
0019 SAMPLING, OIL DISCHARGES, MONITORING, LEGISLATION, ANALYTICAL TECHNIQUES, WASTEWATERS, UK,
0020 SAMPLING, RECLAMATION, MONITORING, EQUIPMENT, DETECTION,
0026 SAMPLING, MASSACHUSETTS, HYDROCARBONS , CHROMATOGRAPHY, CHEMICAL ANALYSIS, SEDIMENTS, *BUZZARDS BAY,
0028 SAMPLING, MOVEMENT, MEDITERRANEAN SEA, FATE, BEHAVIOR, SEA SURFACE,
0027 SAMPLING, PETROLEUM PRODUCTS, CHEMICAL ANALYSIS, SEAWATER, *NAGASAKI BAY,
0029 SAMPLING, FUEL OIL, DETECTION, CRUDE OIL, CHEMICAL ANALYSIS, WSF, *METHOD COMPARISON,
0030 SAMPLING, PETROLEUM PRODUCTS, CHESAPEAKE BAY, BIODEGRADATION, SEAWATER, SEDIMENTS, *MUTAGENIC SUBSTANCES,
0172 SAMPLING, PLANTS, OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, *SPECIES REDUCTION,
0173 SAMPLING, PLANTS, OIL SPILLS, MARSHES, FRESHWATER, BIOLOGICAL EFFECTS, *SPECIES REDUCTION,
0234 SAMPLING, FATE, ENVIRONMENTAL EFFECTS, ARGO MERCHANT SPILL, *WOODS HOLE OCEANOGRAPHIC INSTITUTION,
R016 SAMPLING, PUGET SOUND, MICROORGANISMS, CRUDE OIL, BIODEGRADATION,
R001 SAMPLING, PUGET SOUND, MOLLUSKS, CHEMICAL ANALYSIS, BASELINE STUDIES, SEDIMENTS,
R002 SAMPLING, MICROORGANISMS, CONTAMINANTS, WASTEWATERS, *PRESERVATION,
0008 SANTA BARBARA CHANNEL, POLLUTION PREVENTION, OIL INDUSTRY, EKOFISK BLOWOUT, ARGO MERCHANT SPILL, TORREY CANYON, TANKERS,
0074 SANTA BARBARA CHANNEL, EQUIPMENT, SPILL CLEANUP, SPILL RECOVERY, *SUBMERGED CANOPIES,
0244 SANTA BARBARA CHANNEL, PLATFORMS, OFFSHORE PRODUCTION, MARINE ORGANISMS, BIOLOGICAL EFFECTS,DRILLING , SEDIMENTS,
0260 SCOTLAND, ONSHORE IMPACTS, OFFSHORE DEVELOPMENT, US, *PLANNING,
0028 SEA SURFACE, SAMPLING, MOVEMENT, MEDITERRANEAN SEA, FATE, BEHAVIOR,
0222 SEA SURFACE, OIL SLICKS, *RADIOLOCATION SIGNALS,
0294 SEA SURFACE, OIL TRANSPORT, OIL SLICKS, OIL DISCHARGES, OCS, NEW YORK, MOVEMENT,
0024 SEAWATER, REMOTE SENSING, OIL SLICKS, *LIDAR ENERGETICS,
0027 SEAWATER, SAMPLING, PETROLEUM PRODUCTS, CHEMICAL ANALYSIS, *NAGASAKI BAY,
0030 SEAWATER, SAMPLING, PETROLEUM PRODUCTS, CHESAPEAKE BAY, BIODEGRADATION, SEDIMENTS, *MUTAGENIC SUBSTANCES,
0032 SEAWATER, FRESHWATER, EXTRACTION, ANALYTICAL TECHNIQUES, SURFACTANTS, WASTEWATERS,
0134 SEAWATER, OIL-WATER SEPARATION, FLOTATION, EMULSIONS, SURFACTANTS,
0276 SEAWATER, CRUDE OIL, BIODEGRADATION, *NUTRIENTS, *RESPIROMETRIC METHOD,
0281 SEAWATER, HYDROCARBONS , BIODEGRADATION, BACTERIA, USSR, *N-ALKANES,
0295 SEAWATER, MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, DISTRIBUTION, SEDIMENTS,
0297 SEAWATER, HYDROCARBONS , BIODEGRADATION, SEDIMENTS, WEATHERING, *PHOTOOXIDATION ,
0302 SEAWATER, FILTRATION , FATE, DISTRIBUTION, ATLANTIC OCEAN, TAR,
R003 SEAWATER, OIL TRANSPORT, OIL INDUSTRY, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEDIMENT, *TRANSPORT, STATE GOVERNMENTS, WASHINGTON,
0285 SEDIMENTATION, MOVEMENT, MASSACHUSETTS, INDUSTRIES, HARBORS, *NEW BEDFORD HARBOR,
0292 SEDIMENTATION, RESTORATION, HYDROCARBONS , FATE, ESTUARIES, DELAWARE, *CORINTHOS OIL SPILL,
0026 SEDIMENTS, SAMPLING, MASSACHUSETTS, HYDROCARBONS , CHROMATOGRAPHY, CHEMICAL ANALYSIS, *BUZZARDS BAY,
0030 SEDIMENTS, SEAWATER, SAMPLING, PETROLEUM PRODUCTS, CHESAPEAKE BAY, BIODEGRADATION, *MUTAGENIC SUBSTANCES,

0033 SEDIMENTS, RIVERS, PAH, LAKES , ANALYTICAL TECHNIQUES,
0052 SEDIMENTS, MARINE ORGANISMS, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, ALASKA, SOURCE IDENTIFICATION, *PRUDHOE BAY,
0181 SEDIMENTS, MOLLUSKS, HYDROCARBONS , TOXICITY, *CARBON FLUX, *MYA ARENARIA,
0184 SEDIMENTS, RESTORATION, OIL SPILLS, MASSACHUSETTS, MARSHES, FUEL OIL, *MARSH GRASS,
0204 SEDIMENTS, INTERTIDAL ZONE, CRUDE OIL, BIOLOGICAL EFFECTS, BIODEGRADATION, BACTERIA, ALASKA, *PORT VALDEZ,
0225 SEDIMENTS, HYDROCARBONS , CRUDE OIL, CANADA, *N FIXATION,
0244 SEDIMENTS, SANTA BARBARA CHANNEL, PLATFORMS, OFFSHORE PRODUCTION, MARINE ORGANISMS, BIOLOGICAL EFFECTS,DRILLING ,
0295 SEDIMENTS, SEAWATER, MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, DISTRIBUTION,
0297 SEDIMENTS, SEAWATER, HYDROCARBONS , BIODEGRADATION, WEATHERING, *PHOTOOXIDATION ,
R001 SEDIMENTS, SAMPLING, PUGET SOUND, MOLLUSKS, CHEMICAL ANALYSIS, BASELINE STUDIES,
0058 SHIPS, EQUIPMENT, DESIGN-ENGINEERING, BOOMS, SPILL CONTAINMENT,
0057 SKIMMERS, EQUIPMENT, SPILL CLEANUP, SPILL RECOVERY,
0059 SKIMMERS, SPILL RECOVERY, *PRODUCT INFORMATION,
0060 SKIMMERS, BOOMS, SPILL RECOVERY,
0061 SKIMMERS, SPILL RECOVERY, *"MINISKIMMER",
0062 SKIMMERS, EQUIPMENT, BOOMS, SPILL CLEANUP,
0063 SKIMMERS, EQUIPMENT, SPILL RECOVERY,
0076 SKIMMERS, POLLUTION PREVENTION, OIL SPILLS, LEGISLATION, BOOMS, SPILL CLEANUP,
0096 SLUDGE , REFINERIES, INCINERATION, WASTEWATER TREATMENT, USSR, *WATER PURIFICATION,
0112 SLUDGE , REFINERIES, RECLAMATION, PATENT, OIL-WATER SEPARATION,
0116 SLUDGE , PATENT, OIL TANKS, CRUDE OIL, *SLUDGE REMOVAL,
0124 SLUDGE , DRILLING , DISPOSAL , COST ANALYSIS, WASTEWATER TREATMENT,
0230 SLUDGE , PETROLEUM PRODUCTS, OIL SPILLS, FATE, CRUDE OIL, BIOLOGICAL EFFECTS, SOURCES,
0277 SLUDGE , OIL SPILLS, DISPOSAL , BIODEGRADATION, SOIL, *AERATION, *NUTRIENT ADDITION,
0081 SOIL, RESTORATION, MICROORGANISMS, DECOMPOSITION, CRUDE OIL, CONTAMINATION, *NIGERIA,
0277 SOIL, SLUDGE , OIL SPILLS, DISPOSAL , BIODEGRADATION, *AERATION, *NUTRIENT ADDITION,
0280 SOIL, REFINERIES, BIODEGRADATION, WASTE OIL DISPOSAL, *SOIL CULTIVATION PROCESS, *LEAD,
0109 SOLID WASTES, POLLUTION CONTROL, INDUSTRIES, COST ANALYSIS, WASTEWATER TREATMENT,
0114 SOLID WASTES, DRILLING , DISPOSAL , *OIL BASE DRILLING MUDS, *DRILL CUTTINGS,
0009 SOURCE IDENTIFICATION, OIL SLICKS, CANADA,
0036 SOURCE IDENTIFICATION, PETROLEUM PRODUCTS, CHROMATOGRAPHY,
0038 SOURCE IDENTIFICATION, PETROLEUM PRODUCTS, FUEL OIL, CRUDE OIL, SPECTROSCOPY,
0045 SOURCE IDENTIFICATION, PRODUCTION , MISSISSIPPI RIVER, MEXICO/GULF OF, HYDROCARBONS ,
0046 SOURCE IDENTIFICATION, WEATHERING, SPECTROSCOPY, *COMPUTER ANALYSIS,
0047 SOURCE IDENTIFICATION, CRUDE OIL, CHEMICAL ANALYSIS, *TRACE ELEMENTS,
0048 SOURCE IDENTIFICATION, CRUDE OIL, SPECTROSCOPY, STATISTICAL ANALYSIS, WEATHERING,
0049 SOURCE IDENTIFICATION, RESIDUAL OILS, PETROLEUM PRODUCTS, FUEL OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS,
0050 SOURCE IDENTIFICATION, RESIDUAL OILS, PETROLEUM PRODUCTS, STATISTICAL ANALYSIS, *INFRARED SPECTROPHOTOMETRY,
0051 SOURCE IDENTIFICATION, PLATFORMS, OIL TERMINAL, OIL DISCHARGES, OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION, TANKERS,
0052 SOURCE IDENTIFICATION, SEDIMENTS, MARINE ORGANISMS, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, ALASKA, *PRUDHOE BAY,
0160 SOURCE IDENTIFICATION, CONTINGENCY PLANNING, ARGO MERCHANT SPILL, SPILL CLEANUP, SPILL RECOVERY, USCG,
0165 SOURCE IDENTIFICATION, OIL SPILLS, NORTH SEA, MORTALITY, ENGLAND, BIRDS,
0007 SOURCES, OIL SPILLS, INFORMATION SYSTEMS, *SPILL DIRECTORY,
0079 SOURCES, POLLUTION PREVENTION, DISPERSIONS, BIODEGRADATION, SPILL CLEANUP, STATISTICAL ANALYSIS,
0230 SOURCES, SLUDGE , PETROLEUM PRODUCTS, OIL SPILLS, FATE, CRUDE OIL, BIOLOGICAL EFFECTS,
0263 SOURCES, OFFSHORE PRODUCTION, MARINE ORGANISMS, HYDROCARBONS , ENVIRONMENTAL EFFECTS, CHROMATOGRAPHY,
0038 SPECTROSCOPY, SOURCE IDENTIFICATION, PETROLEUM PRODUCTS, FUEL OIL, CRUDE OIL,
0046 SPECTROSCOPY, SOURCE IDENTIFICATION, WEATHERING, *COMPUTER ANALYSIS,
0048 SPECTROSCOPY, SOURCE IDENTIFICATION, CRUDE OIL, STATISTICAL ANALYSIS, WEATHERING,
0010 SPILL CLEANUP, EKOFISK BLOWOUT, CONTINGENCY PLANNING, SPILL CONTAINMENT,
0025 SPILL CLEANUP, REMOTE SENSING , OIL SPILLS, EPA, *REMOTE SENSING SYSTEMS,
0055 SPILL CLEANUP, DESIGN-ENGINEERING, SPILL RECOVERY,
0057 SPILL CLEANUP, SKIMMERS, EQUIPMENT, SPILL RECOVERY,
0062 SPILL CLEANUP, SKIMMERS, EQUIPMENT, BOOMS,
0064 SPILL CLEANUP, POLLUTION CONTROL, *CHEMICAL AGENTS, *HAZARDOUS CHEMICALS,
0066 SPILL CLEANUP, DISPERSIONS, BIODEGRADATION, ADSORPTION, SPILL DISPOSAL,
0067 SPILL CLEANUP, OFFSHORE DEVELOPMENT, MODELS, MASSACHUSETTS, GEORGES BANK, CONTINGENCY PLANNING,
0068 SPILL CLEANUP, ABSORPTION, *SORBENT BROADCASTER,
0069 SPILL CLEANUP, POLLUTION CONTROL, ENGLAND, *SURFACE FILM-FORMING CHEMICALS,
0070 SPILL CLEANUP, POLLUTION PREVENTION, OIL-WATER SEPARATION, INDUSTRIES, EQUIPMENT,
0071 SPILL CLEANUP, ABSORPTION, *KAPOK FIBER,
0072 SPILL CLEANUP, PATENT, ADSORPTION,

0073 SPILL CLEANUP, PATENT, ABSORPTION, *PLANT FIBER MAT,
0074 SPILL CLEANUP, SANTA BARBARA CHANNEL, EQUIPMENT, SPILL RECOVERY, *SUBMERGED CANOPIES,
0075 SPILL CLEANUP, ICE, CANADA, BEAUFORT SEA, SPILL RECOVERY, *POLAR PACK ICE ,
0076 SPILL CLEANUP, SKIMMERS, POLLUTION PREVENTION, OIL SPILLS, LEGISLATION, BOOMS,
0077 SPILL CLEANUP, PATENT, OIL SLICKS, DISPERSANTS, *RESIN,
0078 SPILL CLEANUP, PATENT, *COLLECTING AGENT,
0079 SPILL CLEANUP, SOURCES, POLLUTION PREVENTION, DISPERSIONS, BIODEGRADATION, STATISTICAL ANALYSIS,
0080 SPILL CLEANUP, POLLUTION PREVENTION, CONTINGENCY PLANNING, US,
0143 SPILL CLEANUP, PATENT, OIL-WATER SEPARATION, GRAVITY SEPARATION,
0150 SPILL CLEANUP, NORWAY, NORTH SEA, EQUIPMENT, EKOFISK BLOWOUT, DESIGN-ENGINEERING, CONTINGENCY PLANNING,
0151 SPILL CLEANUP, HABITAT, FISH, BIRDS,
0152 SPILL CLEANUP, EPA, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, SPILL CONTAINMENT, *RESEARCH PROGRAMS,
0153 SPILL CLEANUP, POLLUTION CONTROL, NOAA, MONITORING, FATE, BIOLOGICAL EFFECTS, BEHAVIOR, *RESEARCH PROGRAMS,
0156 SPILL CLEANUP, POLLUTION CONTROL, PERSONNEL TRAINING, BEHAVIOR, ARGO MERCHANT SPILL, TANKERS,
0157 SPILL CLEANUP, POLLUTION PREVENTION, PERSONNEL TRAINING, EQUIPMENT, ARGO MERCHANT SPILL, TANKERS,
0160 SPILL CLEANUP, SOURCE IDENTIFICATION, CONTINGENCY PLANNING, ARGO MERCHANT SPILL, SPILL RECOVERY, USCG,
0233 SPILL CLEANUP, OIL SPILLS, SPILL DISPOSAL,
0235 SPILL CLEANUP, OIL SPILLS, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, SURFACTANTS,
0237 SPILL CLEANUP, OIL SPILLS, BIODEGRADATION, TOXICITY, *INDUSTRIAL POLLUTANTS,
0304 SPILL CLEANUP, REGULATIONS, POLLUTION CONTROL, OIL DISCHARGES, USCG,
0306 SPILL CLEANUP, OIL SPILLS, LIABILITY, INTERNATIONAL CONVENTIONS, COMPENSATION, *OIL SPILL FUND,
0010 SPILL CONTAINMENT, SPILL CLEANUP, EKOFISK BLOWOUT, CONTINGENCY PLANNING,
0053 SPILL CONTAINMENT, PATENT, YEASTS, *GELLING AGENT,
0054 SPILL CONTAINMENT, PATENT, ADSORPTION, *COLLECTING AGENT,
0058 SPILL CONTAINMENT, SHIPS, EQUIPMENT, DESIGN-ENGINEERING, BOOMS,
0065 SPILL CONTAINMENT, MODELS, EQUIPMENT, *STREAMING-FIBER SYSTEM,
0083 SPILL CONTAINMENT, PORTS, POLLUTION PREVENTION, OIL TRANSFER, LEAKAGE, *CONTAINMENT RING,
0152 SPILL CONTAINMENT, SPILL CLEANUP, EPA, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS, *RESEARCH PROGRAMS,
0066 SPILL DISPOSAL, SPILL CLEANUP, DISPERSIONS, BIODEGRADATION, ADSORPTION,
0233 SPILL DISPOSAL, SPILL CLEANUP, OIL SPILLS,
0055 SPILL RECOVERY, SPILL CLEANUP, DESIGN-ENGINEERING,
0056 SPILL RECOVERY, ADSORPTION,
0057 SPILL RECOVERY, SPILL CLEANUP, SKIMMERS, EQUIPMENT,
0059 SPILL RECOVERY, SKIMMERS, *PRODUCT INFORMATION,
0060 SPILL RECOVERY, SKIMMERS, BOOMS,
0061 SPILL RECOVERY, SKIMMERS, *"MINISKIMMER",
0063 SPILL RECOVERY, SKIMMERS, EQUIPMENT,
0074 SPILL RECOVERY, SPILL CLEANUP, SANTA BARBARA CHANNEL, EQUIPMENT, *SUBMERGED CANOPIES,
0075 SPILL RECOVERY, SPILL CLEANUP, ICE, CANADA, BEAUFORT SEA, *POLAR PACK ICE ,
0160 SPILL RECOVERY, SPILL CLEANUP, SOURCE IDENTIFICATION, CONTINGENCY PLANNING, ARGO MERCHANT SPILL, USCG,
0226 SPREADING, DISPERSIONS, CHEMICAL EFFECTS, TOXICITY,
0282 SPREADING, OCEANS, MODELS, CONTAMINANTS,
0206 ST. LAWRENCE RIVER, HABITAT, DISTRIBUTION, CANADA, BIRDS, BIOLOGICAL EFFECTS,
0123 STATE GOVERNMENTS, REGULATIONS, OIL FIELDS, DRILLING , WASTE OIL DISPOSAL, TEXAS,
0250 STATE GOVERNMENTS, REGULATIONS, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION, US GOVERNMENT,
R003 STATE GOVERNMENTS, SEAWATER, OIL TRANSPORT, OIL INDUSTRY, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEDIMENT, *TRANSPORT, WASHINGTON,
0011 STATISTICAL ANALYSIS, OIL SPILLS, TANKERS, US, *BARGES,
0048 STATISTICAL ANALYSIS, SPECTROSCOPY, SOURCE IDENTIFICATION, CRUDE OIL, WEATHERING,
0050 STATISTICAL ANALYSIS, SOURCE IDENTIFICATION, RESIDUAL OILS, PETROLEUM PRODUCTS, *INFRARED SPECTROPHOTOMETRY,
0079 STATISTICAL ANALYSIS, SPILL CLEANUP, SOURCES, POLLUTION PREVENTION, DISPERSIONS, BIODEGRADATION,
0291 STATISTICAL ANALYSIS, OIL SPILLS, OFFSHORE DEVELOPMENT, OCS, MODELS, *SPILL TRAJECTORY,
0004 STATISTICS, OIL SPILLS, ARGO MERCHANT SPILL, TANKERS,
0006 STATISTICS, OIL SPILLS, NORTH SEA, BIRDS, UK,
0087 STATISTICS, OIL TRANSPORT, OIL SPILLS, LEAKAGE, TANKERS, US,
0161 STATISTICS, SAFETY, OIL DISCHARGES, OFFSHORE EXPLORATION, MEXICO/GULF OF, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL MANAGEMENT, ATLANTIC COAST,
0249 STORAGE, OFFSHORE DEVELOPMENT, MEXICO/GULF OF, FISHERIES, FEA, ENVIRONMENTAL EFFECTS, *SHRIMP, *SALT DOMES,
0175 SUBARCTIC REGIONS, MARINE ORGANISMS, ARCTIC, ACUTE EFFECTS, TOXICITY, *BIOASSAYS,
0205 SUBARCTIC REGIONS, HYDROCARBONS , FISH, ARCTIC, SUBLETHAL EFFECTS,

0240 SUBARCTIC REGIONS, MARINE ORGANISMS, INTERTIDAL ZONE, HABITAT, ECOSYSTEMS, BIOLOGICAL EFFECTS, ARCTIC,
0256 SUBARCTIC REGIONS, OIL SPILLS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, ARCTIC,
0167 SUBLETHAL EFFECTS, MORTALITY, HYDROCARBONS , FUEL OIL, FISH, CRUDE OIL, WSF, *HATCHING SUCCESS,
0168 SUBLETHAL EFFECTS, PETROLEUM PRODUCTS, MORTALITY, CRUSTACEANS, CONTAMINATION, *HOMARUS AMERICANUS,
0179 SUBLETHAL EFFECTS, DISPERSANTS, CRUSTACEANS, BIOLOGICAL EFFECTS, *CRANGON CRANGON,
0182 SUBLETHAL EFFECTS, HYDROCARBONS , FISH, CRUDE OIL, *COHO SALMON,
0188 SUBLETHAL EFFECTS, INVERTEBRATES, HYDROCARBONS , BEHAVIOR, BACTERIA, ALGAE, *CHEMORECEPTION,
0195 SUBLETHAL EFFECTS, MARINE ORGANISMS, HYDROCARBONS , BIOLOGICAL EFFECTS,
0205 SUBLETHAL EFFECTS, SUBARCTIC REGIONS, HYDROCARBONS , FISH, ARCTIC,
0213 SUBLETHAL EFFECTS, RELEASE, MARINE ORGANISMS, HYDROCARBONS , CHRONIC EFFECTS, TOXICITY, UPTAKE,
0217 SUBLETHAL EFFECTS, RELEASE, METABOLISM, MARINE ORGANISMS, HYDROCARBONS , UPTAKE, *BIOCHEMICAL CHANGES,
R014 SUBLETHAL EFFECTS, GUIDELINES, FUEL OIL, BIRDS, TOXICITY,
0032 SURFACTANTS, SEAWATER, FRESHWATER, EXTRACTION, ANALYTICAL TECHNIQUES, WASTEWATERS,
0040 SURFACTANTS, CRUDE OIL, CHROMATOGRAPHY, CHEMICAL ANALYSIS,
0093 SURFACTANTS, REFINERIES, CONTAMINATION, WASTEWATER TREATMENT, USSR, *DEMULSIFIER,
0128 SURFACTANTS, PATENT, EMULSIONS, WASTEWATER TREATMENT,
0134 SURFACTANTS, SEAWATER, OIL-WATER SEPARATION, FLOTATION, EMULSIONS,
0212 SURFACTANTS, DISTRIBUTION, CRUSTACEANS, TOXICITY, UK, *CLIBANARIUS ERYTHROPUS,
0235 SURFACTANTS, SPILL CLEANUP, OIL SPILLS, ENVIRONMENTAL EFFECTS, CHRONIC EFFECTS,
0021 SURVEILLANCE, OIL SLICKS, MONITORING, DETECTION, *OIL-ON-WATER,
0159 SURVEILLANCE, POLLUTION CONTROL, OIL INDUSTRY, *SURVEY,
0309 SURVEILLANCE, POLLUTION PREVENTION, LEGISLATION, FISHERIES, CANADA, *FISHING LIMIT,
0004 TANKERS, STATISTICS, OIL SPILLS, ARGO MERCHANT SPILL,
0008 TANKERS, SANTA BARBARA CHANNEL, POLLUTION PREVENTION, OIL INDUSTRY, EKOFISK BLOWOUT, ARGO MERCHANT SPILL, TORREY CANYON,
0011 TANKERS, STATISTICAL ANALYSIS, OIL SPILLS, US, *BARGES,
0051 TANKERS, SOURCE IDENTIFICATION, PLATFORMS, OIL TERMINAL, OIL DISCHARGES, OFFSHORE PRODUCTION, NORTH SEA, CONTAMINATION,
0084 TANKERS, POLLUTION PREVENTION, OIL TRANSFER, BALLAST , *COMPUTER SIMULATION SYSTEM,
0085 TANKERS, PIPELINES, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, CRUDE OIL, ALASKA, WATER QUALITY, US, *WEST COAST,
0087 TANKERS, STATISTICS, OIL TRANSPORT, OIL SPILLS, LEAKAGE, US,
0115 TANKERS, RESIDUAL OILS, POLLUTION PREVENTION, OIL TANKS, CRUDE OIL, WASTE OIL DISPOSAL,
0156 TANKERS, SPILL CLEANUP, POLLUTION CONTROL, PERSONNEL TRAINING, BEHAVIOR, ARGO MERCHANT SPILL,
0157 TANKERS, SPILL CLEANUP, POLLUTION PREVENTION, PERSONNEL TRAINING, EQUIPMENT, ARGO MERCHANT SPILL,
0117 TAR, BIOLOGICAL TREATMENT, WASTEWATER TREATMENT, WASTE OIL, *RADIAL CLARIFIERS,
0275 TAR, PLANKTON , OIL SHALE, BIODEGRADATION, BACTERIA, ALGAE,
0302 TAR, SEAWATER, FILTRATION , FATE, DISTRIBUTION, ATLANTIC OCEAN,
0259 TAR SANDS, PRODUCTION , EXTRACTION, ENVIRONMENTAL EFFECTS,
0123 TEXAS, STATE GOVERNMENTS, REGULATIONS, OIL FIELDS, DRILLING , WASTE OIL DISPOSAL,
0008 TORREY CANYON, TANKERS, SANTA BARBARA CHANNEL, POLLUTION PREVENTION, OIL INDUSTRY, EKOFISK BLOWOUT, ARGO MERCHANT SPILL,
0039 TOXICITY, PETROLEUM PRODUCTS, ENVIRONMENTAL EFFECTS, CONTAMINANTS, ANALYTICAL TECHNIQUES,
0121 TOXICITY, OIL INDUSTRY, GUIDELINES, DRILLING , DISPOSAL , WASTEWATERS, *DRILLING FLUIDS,
0122 TOXICITY, REFINERIES, METABOLISM, WASTEWATER TREATMENT, *HOLDING POND,
0170 TOXICITY, GASOLINE, AROMATIC HYDROCARBONS, *AEDES AEGYPTI,
0171 TOXICITY, *DEEMULSIFIERS , *FLY LARVAE, *CHIRONOMUS DORSALIS,
0175 TOXICITY, SUBARCTIC REGIONS, MARINE ORGANISMS, ARCTIC, ACUTE EFFECTS, *BIOASSAYS,
0176 TOXICITY, PETROLEUM PRODUCTS, MOLLUSKS, AROMATIC HYDROCARBONS, *BARNACLES,
0181 TOXICITY, SEDIMENTS, MOLLUSKS, HYDROCARBONS , *CARBON FLUX, *MYA ARENARIA,
0183 TOXICITY, FISH, DEVELOPMENT , *STARRED STURGEON, *DEEMULSIFIERS , *GROWTH,
0190 TOXICITY, LUBRICATING OIL, FUELS , DISPERSANTS, ZOOPLANKTON,
0193 TOXICITY, PETROLEUM PRODUCTS, INTERTIDAL ZONE, CRUSTACEANS, WASTE OIL, *LABORATORY CULTURES,
0196 TOXICITY, MOLLUSKS, HYDROCARBONS , RESPIRATION, *MYTILUS EDULIS,
0197 TOXICITY, HYDROCARBONS , FUEL OIL, FISH, DISPERSANTS, CHEMICAL ANALYSIS, UPTAKE, *OIL-DISPERSANT MIXTURE,
0201 TOXICITY, PETROLEUM PRODUCTS, HYDROCARBONS , CRUSTACEANS, *BALANUS,
0207 TOXICITY, MARSHES, FUEL OIL, FISH, CONTAMINATION, CHRONIC EFFECTS, *BIOCHEMICAL CHANGES,
0208 TOXICITY, METABOLISM, HYDROCARBONS , CRUSTACEANS, *NAPHTHALENE, *LARVAE,
0210 TOXICITY, FUELS , ALGAE, *HYDRAZINES, *LUBRICANT ADDITIVES, *JET ENGINE FUELS,
0211 TOXICITY, METABOLISM, FISH, *DEEMULSIFIERS , *CARP ORGANS, *MORPHOLOGICAL CHANGES,
0212 TOXICITY, SURFACTANTS, DISTRIBUTION, CRUSTACEANS, UK, *CLIBANARIUS ERYTHROPUS,
0213 TOXICITY, SUBLETHAL EFFECTS, RELEASE, MARINE ORGANISMS, HYDROCARBONS , CHRONIC EFFECTS, UPTAKE,

0215 TOXICITY, PAH, LAKES , FUEL OIL, WASTEWATER TREATMENT, *SALAMANDERS, *DIESEL OIL, *ASPHALT,
0219 TOXICITY, FUEL OIL, FISH, *ARIUS FELIS,
0226 TOXICITY, SPREADING, DISPERSIONS, CHEMICAL EFFECTS,
0227 TOXICITY, HYDROCARBONS , CHEMICAL ANALYSIS, *ALKANES, *CYCLOALKANES, *AROMATICS,
0237 TOXICITY, SPILL CLEANUP, OIL SPILLS, BIODEGRADATION, *INDUSTRIAL POLLUTANTS,
0245 TOXICITY, PLANTS, DRILLING , *GROWTH, *DRILLING FLUID COMPONENTS,
0246 TOXICITY, MORTALITY, FISH, DRILLING , ARCTIC, *SALMO GAIRDNERI, *DRILLING MUDS,
0247 TOXICITY, OIL WELLS, FISH, ENVIRONMENTAL EFFECTS, DRILLING , *SALMON, *DRILLING MUDS,
0255 TOXICITY, MARINE ORGANISMS, DRILLING , *SHRIMP, *DRILLING FLUID ADDITIVES,
0287 TOXICITY, OXIDATION, FUEL OIL, BIOLOGICAL EFFECTS, YEASTS, *PHOTOOXIDATION ,
0288 TOXICITY, OXIDATION, MARINE ORGANISMS, FUEL OIL, BIOLOGICAL EFFECTS, *PHOTOOXIDATION ,
R014 TOXICITY, SUBLETHAL EFFECTS, GUIDELINES, FUEL OIL, BIRDS,
R009 TOXICITY, FUELS , FISH, CHRONIC EFFECTS, ACUTE EFFECTS, WSF,
R010 TOXICITY, HYDROCARBONS , HEALTH HAZARDS, FISH, BIRDS, *ALTERED MEMBRANE,
0006 UK, STATISTICS, OIL SPILLS, NORTH SEA, BIRDS,
0019 UK, SAMPLING, OIL DISCHARGES, MONITORING, LEGISLATION, ANALYTICAL TECHNIQUES, WASTEWATERS,
0135 UK, OIL-WATER SEPARATION, OIL DISCHARGES, NORTH SEA, ENVIRONMENTAL EFFECTS, CRUDE OIL, WASTEWATER TREATMENT,
0174 UK, MORTALITY, CONTAMINATION, BIRDS, *SEABIRDS ,
0212 UK, TOXICITY, SURFACTANTS, DISTRIBUTION, CRUSTACEANS, *CLIBANARIUS ERYTHROPUS,
0102 ULTRAFILTRATION, REFINERIES, WASTEWATER TREATMENT, *MEMBRANE TECHNIQUES,
0308 UN, POLLUTION CONTROL, MONITORING, MEDITERRANEAN SEA, INTERNATIONAL CONVENTIONS, ECONOMICS, *UNEP,
0197 UPTAKE, TOXICITY, HYDROCARBONS , FUEL OIL, FISH, DISPERSANTS, CHEMICAL ANALYSIS, *OIL-DISPERSANT MIXTURE,
0199 UPTAKE, MICROORGANISMS, HYDROCARBONS , *ADHESION,
0200 UPTAKE, MICROORGANISMS, HYDROCARBONS , *GROWTH KINETICS,
0213 UPTAKE, TOXICITY, SUBLETHAL EFFECTS, RELEASE, MARINE ORGANISMS, HYDROCARBONS , CHRONIC EFFECTS,
0217 UPTAKE, SUBLETHAL EFFECTS, RELEASE, METABOLISM, MARINE ORGANISMS, HYDROCARBONS , *BIOCHEMICAL CHANGES,
0221 UPTAKE, PAH, MOLLUSKS, FISH, CARCINOGENS, BLACK SEA,
0011 US, TANKERS, STATISTICAL ANALYSIS, OIL SPILLS, *BARGES,
0080 US, SPILL CLEANUP, POLLUTION PREVENTION, CONTINGENCY PLANNING,
0085 US, TANKERS, PIPELINES, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, CRUDE OIL, ALASKA, WATER QUALITY, *WEST COAST,
0086 US, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, EIS, CRUDE OIL, ALASKA,
0087 US, TANKERS, STATISTICS, OIL TRANSPORT, OIL SPILLS, LEAKAGE,
0260 US, SCOTLAND, ONSHORE IMPACTS, OFFSHORE DEVELOPMENT, *PLANNING,
0303 US, OIL INDUSTRY, LEGISLATION, CALIFORNIA, *COASTAL ZONE MANAGEMENT,
0310 US, LEGISLATION, INDUSTRIES, GUIDELINES, EPA, WATER QUALITY, *EFFLUENT LIMITATIONS,
0012 USCG, RIVERS, REMOTE SENSING, MONITORING, LAKES , DETECTION, COASTS, BAYS, *CONTINUOUS WAVE LASER,
0023 USCG, REMOTE SENSING, NATURAL SEEPAGE, CALIFORNIA, *RADAR SYSTEMS,
0160 USCG, SPILL RECOVERY, SPILL CLEANUP, SOURCE IDENTIFICATION, CONTINGENCY PLANNING, ARGO MERCHANT SPILL,
0304 USCG, SPILL CLEANUP, REGULATIONS, POLLUTION CONTROL, OIL DISCHARGES,
0305 USCG, REGULATIONS, PORTS, OFFSHORE DEVELOPMENT, *DEEPWATER PORT ACT,
0250 US GOVERNMENT, STATE GOVERNMENTS, REGULATIONS, OIL-GAS LEASING, OFFSHORE DEVELOPMENT, ENVIRONMENTAL PROTECTION,
0093 USSR, SURFACTANTS, REFINERIES, CONTAMINATION, WASTEWATER TREATMENT, *DEMULSIFIER,
0096 USSR, SLUDGE , REFINERIES, INCINERATION, WASTEWATER TREATMENT, *WATER PURIFICATION,
0281 USSR, SEAWATER, HYDROCARBONS , BIODEGRADATION, BACTERIA, *N-ALKANES,
0251 VIRGINIA, REFINERIES, ENVIRONMENTAL EFFECTS, EIS, CHESAPEAKE BAY, *OYSTER BEDS,
R003 WASHINGTON, STATE GOVERNMENTS, SEAWATER, OIL TRANSPORT, OIL INDUSTRY, HYDROCARBONS , CHEMICAL ANALYSIS, BENTHOS, SEDIMENT, *TRANSPORT,
0117 WASTE OIL, TAR, BIOLOGICAL TREATMENT, WASTEWATER TREATMENT, *RADIAL CLARIFIERS,
0147 WASTE OIL, RECYCLING, MODELS, LEGISLATION, ENVIRONMENTAL PROTECTION,
0148 WASTE OIL, RECLAMATION, LUBRICATING OIL,
0193 WASTE OIL, TOXICITY, PETROLEUM PRODUCTS, INTERTIDAL ZONE, CRUSTACEANS, *LABORATORY CULTURES,
0115 WASTE OIL DISPOSAL, TANKERS, RESIDUAL OILS, POLLUTION PREVENTION, OIL TANKS, CRUDE OIL,
0123 WASTE OIL DISPOSAL, TEXAS, STATE GOVERNMENTS, REGULATIONS, OIL FIELDS, DRILLING ,
0280 WASTE OIL DISPOSAL, SOIL, REFINERIES, BIODEGRADATION, *SOIL CULTIVATION PROCESS, *LEAD,
0092 WASTE OIL TREATMENT, PATENT, INCINERATION, FUEL OIL,
0099 WASTE OIL TREATMENT, OIL-WATER SEPARATION, INDUSTRIES, WASTEWATER TREATMENT, *TREATMENT PROCESSES,
0130 WASTE OIL TREATMENT, PATENT, LUBRICATING OILS,
0019 WASTEWATERS, UK, SAMPLING, OIL DISCHARGES, MONITORING, LEGISLATION, ANALYTICAL TECHNIQUES,
0032 WASTEWATERS, SURFACTANTS, SEAWATER, FRESHWATER, EXTRACTION, ANALYTICAL TECHNIQUES,
0103 WASTEWATERS, REFINERIES, CHEMICAL ANALYSIS, *HEAVY METALS,
0113 WASTEWATERS, POLLUTION PREVENTION, OFFSHORE DRILLING, DISPOSAL , *OILY DRILL CUTTINGS,

0121 WASTEWATERS, TOXICITY, OIL INDUSTRY, GUIDELINES, DRILLING , DISPOSAL , *DRILLING FLUIDS,
0261 WASTEWATERS, PIPELINES, OIL SPILLS, MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BALLAST , ALASKA, *PORT VALDEZ,
R002 WASTEWATERS, SAMPLING, MICROORGANISMS, CONTAMINANTS, *PRESERVATION,
0088 WASTEWATER TREATMENT, REFINERIES, ECONOMICS, COST ANALYSIS, WATER QUALITY,
0090 WASTEWATER TREATMENT, REFINERIES, PATENT, ACTIVATED SLUDGE,
0093 WASTEWATER TREATMENT, USSR, SURFACTANTS, REFINERIES, CONTAMINATION, *DEMULSIFIER,
0095 WASTEWATER TREATMENT, PATENT, INCINERATION, FUEL OIL, EMULSIONS,
0096 WASTEWATER TREATMENT, USSR, SLUDGE , REFINERIES, INCINERATION, *WATER PURIFICATION,
0097 WASTEWATER TREATMENT, REFINERIES, *GRANULAR CARBON, *POWDERED CARBON,
0099 WASTEWATER TREATMENT, WASTE OIL TREATMENT, OIL-WATER SEPARATION, INDUSTRIES, *TREATMENT PROCESSES,
0101 WASTEWATER TREATMENT, OIL TERMINAL, NORTH SEA, EQUIPMENT, BALLAST ,
0102 WASTEWATER TREATMENT, ULTRAFILTRATION, REFINERIES, *MEMBRANE TECHNIQUES,
0104 WASTEWATER TREATMENT, RESIDUAL OILS, RECYCLING, PATENT, MONITORING, ANALYTICAL TECHNIQUES, *INFRARED ANALYZER,
0106 WASTEWATER TREATMENT, PETROLEUM PRODUCTS, FLOTATION,
0107 WASTEWATER TREATMENT, DRILLING , DISPOSAL , *MUD SOLIDIFICATION PROCESS,
0108 WASTEWATER TREATMENT, REFINERIES, FLOTATION, FLOCCULATION, *COAGULATION,
0109 WASTEWATER TREATMENT, SOLID WASTES, POLLUTION CONTROL, INDUSTRIES, COST ANALYSIS,
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4,032,444	C-0145
4,033,851	C-0142
USSR Patent	
452,185	C-0118

APPENDIX

Periodicals Reviewed

Alternatives: Perspectives on Society and Environment
Ambio
American Fisheries Society Transactions
Analytical Chemistry
Applied Ecology Abstracts
Applied Energy
Applied Microbiology
Applied Science & Technology Index
Aquatic Sciences & Fisheries Abstracts
Audubon
Australian Science Index
Berichte der Deutschen Wissenschaftlichen Komission fuer
  Meeresforschung
Bibliography and Index of Geology
Biological Abstracts
Bioresearch Index
Bioscience
British Birds
Bulletin of Environmental Contamination and Toxicology
Bulletin of Marine Science
Chemical Abstracts
Chemical and Engineering News
Chemical Engineering
Chemical Engineering Progress
Chemical Week
Chemistry in Canada
Chemosphere
Coastal Zone Management Journal
Conservation News
Current Contents: Life Sciences
Current Contents: Physical and Chemical Sciences
Deep-Sea Research/Oceanographic Bibliography
Ecolibrium
Ecological Abstracts
Ecological Modelling
Ecology Law Quarterly
Energy Information Abstracts
Energy Review
The Engineering Index Monthly
Environment
Environment Abstracts
Environmental Action
Environmental Conservation
Environmental Geology
Environmental Health and Pollution Control
Environmental Periodicals Bibliography

Environmental Pollution
Environmental Research
Environmental Science & Technology
Environmental Technology and Economics
EPA Reports Bibliography Quarterly
ERDA Energy Research Abstracts
Estuarine and Coastal Marine Science
Fuel Abstracts and Current Titles
Government Reports Announcements
Groundwater
Hydrocarbon Processing
India Journal of Environmental Health
Industrial Wastes Information Bulletin
International Aerospace Abstracts
International Journal of Ecology and Environmental Science
International Journal of Environmental Analytical Chemistry
International Journal of Environmental Studies
International Petroleum Abstracts
Iranian Journal of Science and Technology
Journal of Canadian Petroleum Technology
Journal of Chromatography
Journal of Environmental Science and Health
Journal of Environmental Sciences
Journal of the Institute of Water Pollution Control
Journal of Petroleum Technology
Journal of the Fisheries Research Board of Canada
Journal of Toxicology and Environmental Health
Limnology and Oceanography
Marine Biological Association of the United Kingdom, Journal
Marine Biology
Marine Chemistry
Marine Geology
Marine Geotechnology
Marine Policy
Marine Pollution Bulletin
Marine Science Contents Tables
Marine Technology
Marine Technology Society, Journal
Maritime Research Information Service Abstracts
Microbial Ecology
National Fisherman
National Research Council, News Report
National Wildlife
Nature
New Technical Books
Nippon Susan Gakkai Shi. Bulletin of the Japanese Society of Scientific Fisheries
Ocean Engineering
Ocean Industry
Ocean Management
Oceanic Abstracts

Oceanus
Offshore
Oil and Gas Journal
Outdoor California
Pacific Oil World
Petroleum Abstracts
Petroleum Engineer International
Petroleum Today
Pollution Abstracts
Pollution Engineering
Proceedings in Print
Rapports et Proces Verbaux
Resources
Resource Recovery and Conservation
Royal Society of London, Proceedings, Series B, Biological Sciences
Science
Science News
Science of the Total Environment
Scientific and Technical Aerospace Reports
Scientific Meetings
Sea Frontiers
Sea Secrets
Sea Technology
Selected Water Resources Abstracts
Summaries of Foreign Government Environmental Reports
Technical Book Review
The Ecologist
The Engineering Index
The Sciences
Toxicology
UDS Water Quality Control Digest
Underwater Information Bulletin
Underwater Naturalist
Water, Air, and Soil Pollution
Water & Pollution Control
Water Pollution Control Federation, Journal
Water Research
Western Fisheries